AN ARGUS SPECIALIST PUBLICATION
JANUARY 1986
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Your COMMODORE

YOUR BEST INDEPENDENT COMMODORE MAGAZINE

Now Incorporating YOUR 64



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Latest hardware reviewed

DISK EDITOR – latest entry for Programmer of the Year


THE COMMODORE 128.
HARD FACTS ABOUT THE SOFTWARE.
MULTI SOFT
PAZAZZ
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PAZAZZ
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COMMODORE 128
PERSONAL COMPUTER
APPLICATIONS
Script 128
Script 128 is the intelligent, fully professional word processor for your Commodore 128. It offers you all the usual advantages of word processing — cut and paste editing, mail merge, tabs, search and replace, print preview, plus other advanced features such as an arithmetic function for totalling rows and columns, a second text area, wordwrap, 80 or 40 column display and customized printer output with programmable options.
Some of Script 128's powerful features:
* Menu driven operation throughout — with shortcut command options for time saving.
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* Two text areas in 128k machines, allowing two separate documents to be held in memory simultaneously.
* Support for all main printer types, and customising to suit individual user's printing requirements.
MULTI SO
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Personal Money Management helps you make the money go round. It is a straightforward, simple-to-use budgeting program for personal finances with which you can control your domestic cash flow and make the most of your income. With Personal Money Management you need never again be caught by the unexpected bill and no money to pay it.
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Personal Money Management makes planning and budgeting easy, no household should be without it.
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With hundreds of software packages available never has a more useable machine been launched.
Three modes mean you can use software for the Commodore 64, software for the CP/M system and new software specially written.
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Our COMMENT



WELL, HERE WE ARE, THREE ISSUES INTO the merger between Your Commodore and Your 64.

Letters have been flowing in from readers – some of them good, some of them bad. Some people are saying that the 'new' magazine is not Your 64 and that we should re-launch Your 64 as a magazine in its own right. Well, quite simply Your Commodore is not Your 64, it was never intended to be. However, what we did aim to do was to bring together what we considered to be the best parts of both magazines. In these first few issues we have brought you the games reviews and Scratchpad from Your 64. Quite shortly, you should be seeing the re-emergence of Arcade Ace and a number of other features.

Quite a few people have asked us what has happened to the 'Cheats and POKEs' section from Your 64. Our view on this is that if you're going to buy a game, the fun is solving the puzzles set by the programmer. If you're going to cheat why buy it?

This doesn't mean that we aren't open to suggestions. Please let us know what you would like to see in the magazine and we'll see what we can do. Not only have we had mail from people with gripes but we have had an equal number of letters complementing us on the latest issues. One kind reader was over the moon about John McHales character editor and said that "It's material like this that compels us to keep buying your superb magazine". Thank you very much.

Another reader said that "Now my brother loves to read the magazine as well". Well, we do try to cater for all tastes.

A couple of people have said that Your 64 just covered the C64 and that we should do the same. Well I'm afraid our title is Your Commodore and as such we try to cover all the machines that Commodore produces.

If you do have any comments then please write to us and make sure that you tell us what you do like.

Stuart

DATA STATEMENTS

In Touch

MODEM MANIA IS SWEEPING THE country and communications services like Prestel and Micronet are taking full advantage of this growing enthusiasm by adding more and more facilities to their existing systems.

Micronet's efforts to encourage new users to buy modems by enticing them with £10 vouchers when they purchase them from Pace, Miracle or Modem House, is now being stepped up to include Xyllyx.

John Barton, marketing manager for Xyllyx said: "This move towards the consumer end of the industry marks a new phase for us and is a reflection of the increasing importance of the communications field as we see it. Particularly in terms of the home user."

There's also news from the Micronet Gallery where queues of potential exhibitors have formed. Micronet has a plot afoot to weed out those naughty exhibitors who are not using or editing their pages sufficiently.

From 1 December, Gallery is repriced to 99p per frame for four months. Each edit now costs 10p. Existing exhibitors can be transferred to the new pages for a block charge of 99p.

According to Micronet, it is hoped that the changes will mean that only 'serious' exhibitors will book!

Pace Micro Technology is encouraging communications enthusiasts to take to their boats by sponsoring the Round Britain Race on Micronet 800. Entrants who buy a Nightingale modem will qualify for the Pace prize of a return trip to New York for two, plus six nights in a top hotel and £400 spending money.

Micronet's publicity man, Peter Probert commented: "It's good to see a modem company giving out to the people who made them as important as they are i.e. the customers."

Telecom Gold increased its charges from 1 December. Connect time charges for standard rate now cost 11p per minute (0800-1900 Monday to Friday) and cheap rate is 3.5p per minute. Gold Net service charges go up to 2.5p per minute for 300 baud and 3p per minute for 1200 baud. All other charges remain the same.

British Telecom's Multi-User Dungeon (MUD) has been delayed although Telecom says it will be up and running before the end of 1985. All existing subscribers are guaranteed substantial free credit for an initial test period.

The MUD spectacular will now take place in the spring.

The delay has caused frustration to MUD organisers, according to Mike Anderiesz, Launch Manager: "MUD is unique – there hasn't been a program of this size or complexity before. Even so the problems we're experiencing are the kind of last minute bugs every programmer has to deal with. As far as we're concerned the quality of the finished product is more important than the deadline."

Prestel has announced a growth of 44 per cent in the past year with more than one million pages a day being accessed and 100,000 electronic mail messages per week.

Areas which have attracted new users to Prestel are travel, insurance, microcomputing, city information, farming information, home banking, shopping and messaging.

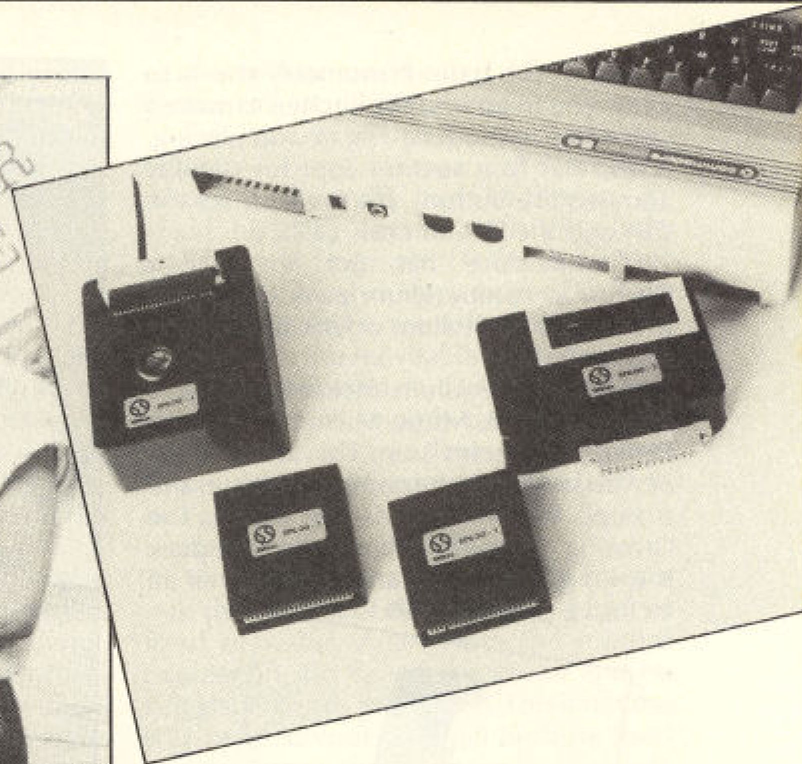
Touchline

Telecom Gold, 60-68 Thomas St, London SE1 3QU
MUD, BT New Information Services, Wellington Hse, Upper St Martins Lane, London WC2H 9DL
Micronet 800, 8 Herbal Hill, London EC1R 5EJ
Prestel, BT Centre, Floor A3, 81, Newgate St, London EC1A 7AJ

Generally Speaking

SIRCAL INSTRUMENTS IS ABOUT TO RElease a complete cartridge and erasure system for the C64.





Included in the system is a programmer unit, a mains powered UV eraser unit, one operating system cartridge and one 8K programmable cartridge.

According to the makers, the system allows even a novice user to create his own cartridge based software in either Basic or m/c.

The UV eraser pack allows complete erasure of cartridges, and the pack features an automatic timer and safety interlock to prevent leakage of ultra violet light.

The pack is called the Epilog-1 Cartridge System and costs £144.95 mail order. Additional cartridges with 8K EPROM are £17.95 or £44.95 for three.

Meanwhile in adventure land, Ian Banff has walked off with £250 as winner of Print'n'Plotter Products' Adventure Planner competition. The competition was based on the use of the Adventure Planner Pad, produced by Print'n'Plotter which enables adventure game players to plan their progress while playing on a computer.

Stuart Cooke, our esteemed editor, was privileged enough to present a cheque for £1000 to Andrew Boosey from Hayes, whose game Pony Express is to be used in a future Games Creator Collection by Mirrorsoft. Stuart is the guy in the middle wearing a tie who looks very reluctant to give up the money!

Want a free poster? Well, you can get one from Level 9 if you send off to the address below. The Level 9 poster has a picture of the new game The Worm in Paradise on the front and on the back it has details of Level 9 adventures. Don't forget to send an s.a.e. or you won't get one.

If you think software piracy is bad in this country then go to Italy. There are no independent software houses there because software piracy is so widespread.

Pirates come to Britain, buy the top selling games and return home, where they pass the tapes on to code crackers who break in, translate the title screens into Italian and then duplicate them. The games are sold at incredibly low prices on compilation tapes costing as little as £4 for as many as 16 games!

A leading Italian magazine publisher, Gruppo Editorial Jackson, is intending to prosecute the pirates and the group is being backed by British software houses.

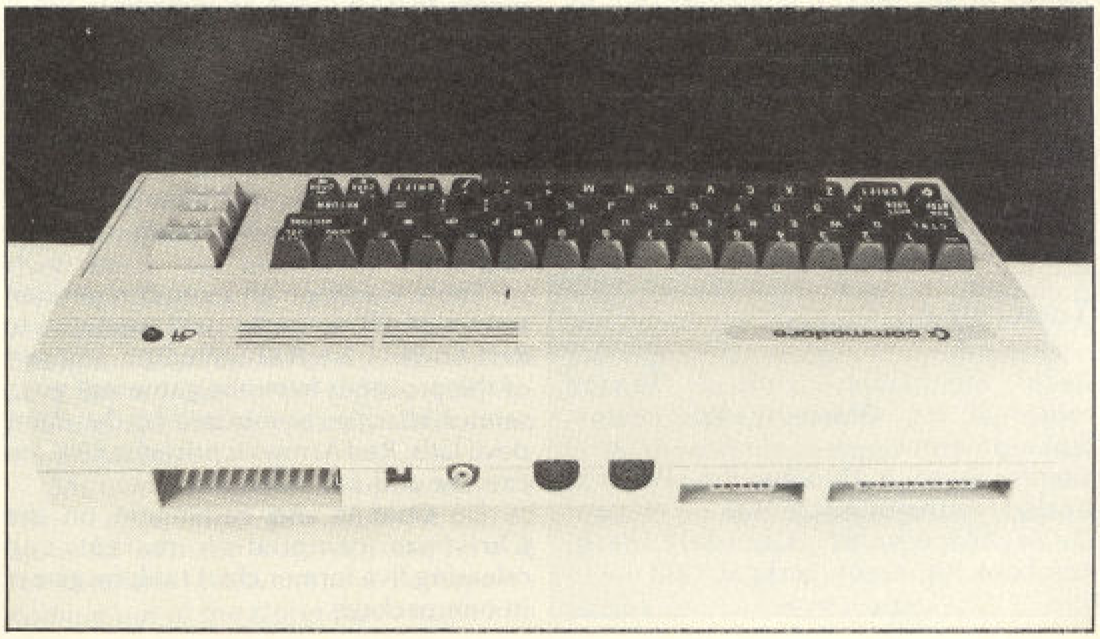
Touchline

Sircal Instruments, 11 Southfields Ct, Sutton, Surrey SM1 3HJ
Print'n'Plotter, 19 Borough High St, London SE1 9SE
Level 9, The Worm in Paradise Offer, PO Box 39, Weston-super-Mare, Avon BS24 9UR



Hard Lines

A new joystick has been devised by Dean Electronics which has 10 feet of cable



stored in the base. Presumably this is to allow you to go into the kitchen to make a cup of tea without having to stop playing. It also has four suction cups for stability and two fire buttons. It's available for the C64 and Vic 20 and costs £6.75.

Commodore has got together a Christmas compendium pack to replace the C64 Micro holiday offer which ended in September.

The compendium includes a C64, a 1520 Datasette, Music Maker, Designer's Pencil from Acitivision, The Secret Diary of Adrian Mole – the computer game, and a copy of the best-selling novel The Growing Pains of Adrian Mole. The pack is even gift wrapped and comes at an all inclusive price of £199.



Datel Electronics has come up with a Digital Sound Sampler for the C64. It is supplied in the form of a hardware unit with a comprehensive software package. The user is able to record any type of sound digitally into memory using the microphone provided or any line source. Once in memory the sound can be replayed at any pitch, forwards, backwards, with echo etc. The software features a full chromatic keyboard allowing the user to play a complete musical piece from a single sampled sound.

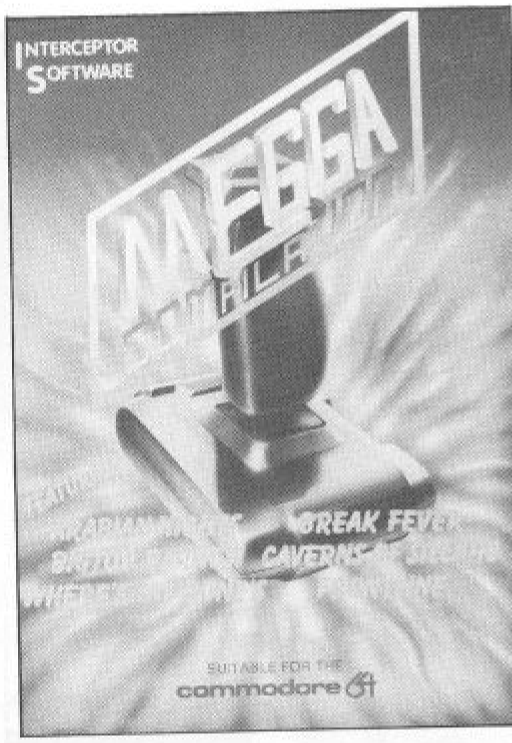
Many other features are included and the sampler costs £49.99.

Touchline

Datel Electronics, Unit 8, Fenton Industrial Est, Dewsbury Rd, Fenton, Stoke-on-Trent

Commodore, 1 Hunters Rd, Weldon, Corby, Northants NN17 1QX

Dean Electronics, Glendale Park, Fernbank Rd, Ascot, Berks SL5 8JB



Soft in the Head

SOFTWARE HOUSES HAVE DEFINITELY been saving a lot of their releases for Christmas. There is a mass of new games flooding into the market at the moment so buyers will be spoilt for choice when shopping for pressies.

From Ariolasoft come three new disk games: Batalyx, Scarabeus and Wizard, all at £12.95. Batalyx is, of course, the first Ariolasoft/Llamasoft release. Out on cassette from Ariolasoft are the construction games: Pinball Construction Set (£11.95), Racing Destruction Set, and Music Construction set (£12.95). Mail Order Monsters is also out at the same price and on cassette.

Interceptor Micros is going for success in the compilation stakes with a cassette entitled Megga-Compilation. It includes six former Interceptor arcade releases: Arabian Nights, Bit Top Barney, Where's My Bones, Break Fever, Caverns of Sillahc and Frontline. This package of games costs £7, which, according to Interceptor, means that you save an incredible £35.

Database Software has brought out a Red Arrows flight Simulator for those who like living dangerously without the danger. The program was written with the co-operation of the Red Arrows pilots and reconstructs the complicated aerial manoeuvres which the team regularly display.

There is a free high score competition to win an all expenses paid weekend to Red Arrows base, RAF Scampton, and part of the proceeds from the game will go to service charities nominated by the dare-devil lads. Red Arrows is priced at £8.95 on cassette and £11.95 on disk.

US Gold is also cashing in on the Christmas compilation market and releasing five former chart ranking games in one package.

The titles included are Tapper, Spy Hunter, Up'n'Down, Blue Max and Aztec Challenge. The compilation has been named Arcade Hall of Fame and is out on both disk and cassette at £12.95 and £9.95 respectively.

A US Gold game also features on a joint package from four software houses. The other companies contributing to the Hitsville pack are Software Projects, Ocean and Ultimate. At £9.95 on cassette and £12.95 on disk the C64 tape features Beach Head, Daley Thompson's Decathlon, Jet Set Willy and Staff of Karnath.

Ocean's David Ward said: "The software producers have worked together to give the public a really good deal for Christmas – this industry is often portrayed as back-stabbing – and this proves we are capable of working in harmony."

Melbourne House has four new games for the C64. Gyroscope, and Mugsy's revvenge both cost £8.95. Big Daddy's Rock'n'Wrestle is £9.95 and the follow-up to The Hobbit – Lord of the Rings Part 1 – is now available. Lord of the Rings includes two cassettes, the paper back novel of The Fellowship of the Ring and a 32 page instruction booklet.

Touchline

Hitsville, C/O 6 Central St, Manchester M2 5NS

US Gold, Unit 10, The Parkway Industrial Centre, Heneage St, Birmingham B7 4LY

Interceptor Micros, Lindin House, The Green, Tadley, Hants

Ariolasoft, Suite 105-106, Asphalte Hse, Palace St, London SW1E 5HS

The Bizz

FIRST PUBLISHING IS OFFERING savings to business users with the launch of a range of products called powerpaks.

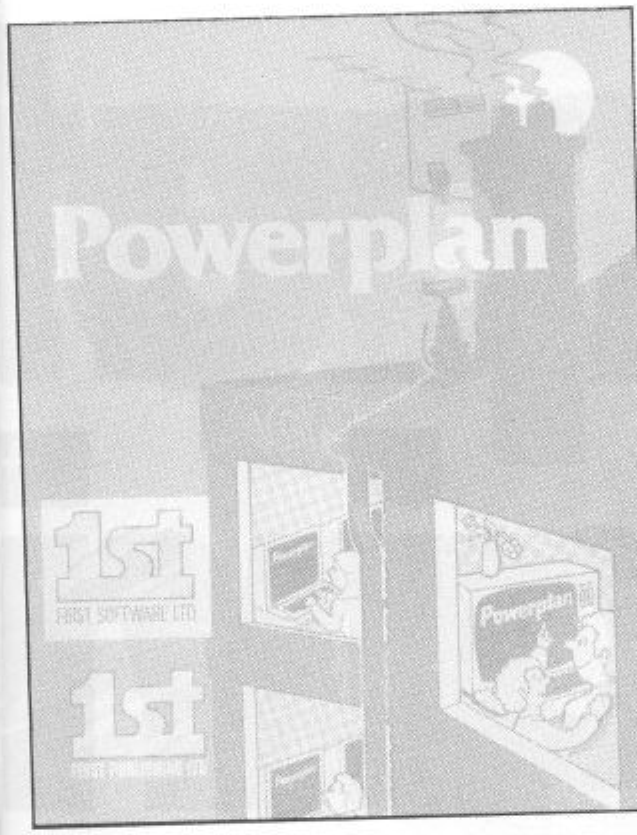
Pak one is made up of Powerplan, FirstWORD and Firstbase and retails at £59.95. Bought separately the three programs would set you back £114. The programs offer a complete spreadsheet, word processing and data storage system and will allow users to upgrade to C128.

Pak two also offers a saving on the Basic 64 Compiler and Assembler/ Monitor 64 which together will retail at £34.95. Both disks are supplied with comprehensive user manuals.

The third pack consists of two books Anatomy of the Commodore 64 and Your 64 Cassette Book which will cost £16.95 instead of the present price of £26. Three new programs have been released by Impex, including a package that will enable the user to improve his output from the dot matrix printer.

The program, called Font Factory offers eight different type faces as well as giving full control over line width, left margin, line spacing, footers, headers justification etc.

The program which retails at £19.95 also includes Signwriter which allows the generation of outsized letters up to 40 characters long and a foot high. Fantastic Filer is a menu driven file management system with one key stroke commands, 50 files per record and a three second search time. The data base costs £12.95.



Also available is Screen Dumper 64 which will transfer to your printer whatever graphics are produced on the screen, including text multi colour sprites and hi-res graphics. The utility even works with a koala pad. The Screen dumper disk retails at £12.95.

Micro-Swift as it is called in Britain is a spreadsheet that has just broke into the Home Management category of the American Billboard Software Chart under the assumed name of Swift Calc. Currently at number ten Swift Calcs manufacturer MDL (Metamorphosis Developments Ltd), are hoping they have a chart topper on their hands. A new version of the Swift spreadsheet will soon be available for the C128.

Invasion of the Little People

HAVE YOU EVER WONDERED WHAT IT is that causes bugs in your programs when everything seems to be in order, or why your telephone bill seems so expensive when you've only accessed Compunet when it's been really essential? Activision seems to think that its programmers have found the answer. A press conference was called to reveal the conclusion that the Activision research team has reached: **There's someone living in your computer!**

Of course this revelation was treated as a joke in the atmosphere of journalistic scepticism which prevailed at the meeting, until they came up with the proof. A stunned audience watched disbelievingly as a monitor screen flickered into life and there it was; a 36mm man living out his open plan existence in an environment specially created by the Activision Little Computer Person (LCP) Research Team.

Many of the case-hardened hacks muttered in disbelief and I must confess to a certain degree of incredulity myself. Now that I have installed my own environment, or house as Activision prefer to call it, I am a total believer. My life changed overnight, no more was I the carefree, footloose person of the previous day because I now had to tend to the needs of my new found charge who depends on me for his very existence.

The LCP Research project started because of one man's conviction that not all of the glitches in his computer programs could be put down to human error. The more Rich Gold thought about it, the more he became convinced that there was some life-form living inside his computer.

In Autumn '84, Gold contacted James Wickstead Associates and the quest to find the little creatures began in earnest. Early in '85 Activision heard about this research team and programmer David Crane was transferred onto the project.

The problem was how to entice these beings into the open and the solution could not have been easier. Create a pleasant living environment which is preferable to that of hot microchips and sharp edged capacitors and only a fool could resist moving in. A three-storeyed house was created with the very latest in mod-cons and soon the door opened and in walked the first LCP to be observed by the human race. It was at this point that Crane was heard to utter thoses immortal words, "Well, how do you do?"

So far two attributes have been noted about LCPs. Firstly, they all appear to be male but we know from letters that the female of the species does exist but appears to be shy and retiring. Secondly, they seem to lead very American lifestyles. This came to light when the researchers got excited at what they first thought was a female of the species but later turned out to be a male LCP exhibiting one of his typically Californian eccentricities.

My own LCP is called Harold and he's a fairly conservative guy. How he's lived alone for so many years with only his dog for company I'll never know. Perhaps it's coming out of the closet that's made him so dependent on me but he certainly demands a lot of attention.

I've observed four basic moods: ecstatic, content, morose and downright miserable. Normally he is content to go about his daily routine with very little interference from me. He feeds himself and his dog, washes up, watches TV, plays the piano, takes extremely long showers and answers the inevitable calls of nature. Occasionally, he starts to look morose and the sides of his mouth turn down in a grimace. This is when I have to intervene. Sometimes a mere pat on the head will do or a gift of a book or a record will alleviate moderate attacks of the blues.

One thing guaranteed to take Harold into the depths of depression is a lack of food or water. Apart from the morose expression, his face turns green and he sluggishly heads for his bed. This is not the way to treat your little pal because food can be left at the doorstep by a simple keypress and similarly water can be added to the water tank in the kitchen.

I'll never forget the day Harold moved in. I'd loaded Activision's house, turned off the lights in my room and sat back waiting patiently. After a short time the door opened and in walked Harold, examined every inch of the house and walked out again. Had I frightened him away? I'd tried not to make a sudden movements. What was wrong? Each second seemed like an eternity and then he reappeared, suitcase in hand and dog at heel. Harold had moved in!

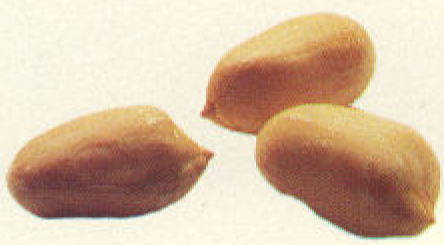
I soon found that, although I could not understand a word he said, I could communicate with him by typing in messages. If I'm polite and always say please and thank you he is usually more than willing to play the piano for me to join in on a mean game of poker, card wars or anagrams. He also spends hours on the phone if left to his own devices and being independent little soul he sometimes refuses to obey my requests.

Harold's life is interesting to watch and interact with but I must guiltily confess to a feeling that he may be like a Christmas puppy. Once the novelty wears off, he may be turfed out of his home back onto the streets and pathways of the printed circuit boards in the netherworld of my computer.

Each computer user will find a different little person in their machine and if he turns out to be boring you will have to buy a new package and hope that a different character takes up residence. He could be another Harold, a lousy piano player, a stroppy individual or the dreaded transvestite mentioned earlier. It's all a bit of a gamble.

At the moment people think I'm crazy but I know better. As I scrape out the remains of dead cowboys and Indians from the back of my TV set, I smile a secret smile knowing that I'm the only sane person in a world of madmen.

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...buy one of thes

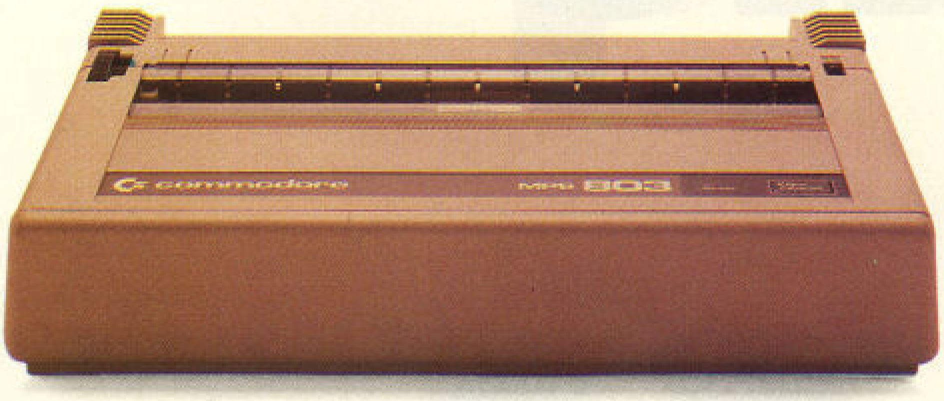
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DGH Software, 10 North Street, Ashford, Kent.
Geerings of Ashford, High Street, Ashford.
Radio 88, 88 Longbridge Road, Barking, Essex.
Alphascan, Chester House, Windsor End, Beaconsfield.
Camden Computers, 462 Coventry Road, Small Heath, Birmingham.
Deane Computers, Sea Road North, Bridport, Dorset.
Empire Electro Centre, 783-789 Leeds Road, Bradford.
Erricks of Bradford, Fotosonic House, Pawson Square, Bradford.
Gamer, 71 Last Street, Brighton.
Gamer, 24 Gloucester Road, Brighton.
High Voltage, 53-59 High Street, Croydon.
Metyclean, 60 George Street, Croydon.
Sarays, 43 Church Street, Croydon.
FBC Systems, 10 Castlefields, Main Centre, Derby.
Gordon Harwood, 69/71 High Street, Derby.
Geerings of Ashford, 13 Bench Street, Dover, Kent.
P & L Cash Registers, Dunstable, Beds.
Adams World of Software, 190c Station Road, Edgware, Middx.
Micro Workshop, Station Approach, Epsom, Surrey.
Geerings of Ashford, 91 Preston Street, Fathersham, Kent.
Trionic Ltd., 144 Station Road, Harrow, Middx.
Geerings of Ashford, 104-106 Mortimer Street, Herne Bay.
Tomorrow's World, 15 Paragon Street, Hull.
Cavendish Commodore Centre, London Road, Leicester.
Dimension, 29/31 Silver Street, Leicester.
Sonic Foto, t/a Rother Cameras Ltd., 256 Tottenham Court Road, London.
Tasha Computers, 191 Kensington High Street, London W8.
Ramsons, 4 Edgware Road, London W2.
West End Video, 6 Marble Arch, London W1.
Micro Anvika, 224 Tottenham Court Road, London W1.
Harp Electronics, 237 Tottenham Court Road, London W1.
Video Vision, 168 Kensington High Street, London W8.
Video World, 260 Tottenham Court Road, London W1.
Sarays, 223 Tottenham Court Road, London.
Sarays, 334 Edgware Road, London.
Sarays, 272 Edgware Road, London.
Gultronics, 200 Tottenham Court Road, London.
Gultronics, 15 Tottenham Court Road, London.
Logic Sales, 19 The Broadway, The Bourne, Southgate, London W14.
Chromasonic, 48 Junction Road, Archway, London N19.
Chromasonic, 238 Muswell Hill, Broadway, Muswell Hill, London N10.
G & B Computers, 242 Tottenham Court Road, London W1.
G & B Computers, 230 Tottenham Court Road, London W1.
Metyclean, 137 The Strand, London.
Metyclean, 92 Victoria Street, London.
Adams World of Software, 779 High Road, North Finchley, London N19.
Hobbyte, Arndale Centre, Luton.
Kent Microcomputers, 57 Union Street, Maidstone, Kent.
Square Deal, 373/375 Footscray Road, New Eltham.
Intoto, 1 Heathcoat Street, Hockley, Nottingham.
Logic Sales, 6 Midgate, Peterborough.
Geerings of Ashford, 25 Queens Street, Ramsgate.
Joe Micro (Rhyl Computer Centre), 20 Russell Road, Rhyl, Clwyd.
MU Games, 245 High Street, Slough.
Hobbyte, 10 Market Place, St. Albans, Herts.
The Model Shop, 22 High Street, Stroud, Glos.
L & J Computers, 192 Honeypot Lane, Queensbury, Stanmore, Middx.
Bucon Microstore, Swansea.
JKL Computers, 7 Windsor Street, Uxbridge, Middx.
Bell & Jones, 39 Queen's Square, West Bromwich.

Ian Waugh blows the horn, puts his foot down and test drives the Sound Buggy.

SOUNDING OFF



IT'S NOT VERY EASY TO PICK OUT A tune on the QWERTY keyboard. It's even less easy to play a tune and create a suitable accompaniment for it. One alternative is a music editor which requires you to enter music a note at a time. If you consider this to be too slow but if you would still like to produce and play music then the Sound Buggy could be for you.

The Buggy comes from the Siel garage at an on the road price of £99 (including VAT and number plates) and it is effectively a self-contained synthesiser, rhythm and accompaniment unit with facilities to record, store and playback melody lines and accompaniment patterns. It hooks on to a C64, the SX and the 128 and the phono and mini jack socket enable you to tune in with headphones or a hi-fi system. Software is available on disk and cassette.

A Siel clip-on keyboard, which clips over the C64's keys, is supplied with the Buggy. You can also use Commodore's clip-on keyboard or Siel's full-size CMK 49. The CMK is obviously a lot easier to play but the mini version works very well and I used it to produce quite an acceptable recording of Axel F.

Options are selected through menu pages and movement and selection within screens is done with the function keys. In case of difficulty, pressing the CMDR key will pull down a help message across the top of the screen. At the time of review, the instruction booklet was not yet available but I had no difficulties at all in using the program.

The SONG-EDIT screen displays the music options in windows. It is entered from the Song Menu screen which is used to select the song you want to play or edit. Nine songs are already stored within the program.

The top left window holds instrument information. Instruments are designed using footage settings of 16, 8, 4 and 2 which are given volumes ranging from nought to 31. The envelope or ADSR (Attack, Sustain, Decay, Release) parameters range from nought to seven and an enveloped option lowers the volume just after playing the note. The program can store 28 sounds and 14 are provided upon loading.

The bottom left window details the rhythm section. This can store 24 rhythms and already holds 14 excellent preprogrammed examples. A rhythm is constructed from five drum sounds: two cymbals, bass, snare and a rim shot. Patterns are entered by stepping through a screen display divided into subdivisions of the beat. Drums are turned on and off at the press of a key and you can see at a glance how a pattern is constructed. New rhythms can be invented very easily.

The bottom right window is the sequencer and controls the sections of the composition you are currently playing and recording. These will be either the melody (solo) line or chords.

From the final window, top right, you can choose one finger chords played by pressing the lower half of the QWERTY keyboard, or you can form your own with the teach option. From the chords played, the program stores chord, bass and arpeggio information. These can be selected individually upon playback. A rhythm option sets the bass and chords into an accompaniment to compliment the drums. Memory holds each chord until a new one is played and a melody function plays a complete chord with every melody note. Vibrato can be switched on or off.

The disk menu gives full control over loading, saving and erasing songs and includes a useful disc formatter.

One of the Buggy's most exciting features is its MIDI section. To use this you need a suitable MIDI interface – such as Siel's – and at least one MIDI-compatible keyboard. The individual music sections of the Buggy can be routed to the keyboard(s) and if you have four, the four sections will play through different instruments producing an absolutely brilliant sound. Even one keyboard produces good results. A MIDI keyboard can be used to control the Buggy, too.

As well as the rather excellent sounds it produces, the Sound Buggy can serve as an information to MIDI interfacing. It's easy to drive, too, so when Siel's boys say, "You gonna come for a ride with us" – you'd better go.


The Commodore 128.
When you look at the facts
they do seem to weigh rather
heavily in our favour.
When you add it up, the Commodore 128 is really three computers in one.
It can run 64K, 128K and CP/M software. Giving it the largest range of computer software in the world. Making it as efficient in business as it is entertaining at home.
That's why Commodore has become the world leader in microcomputers.
And why, on balance, the Commodore 128 has no equal.
commodore

This month we bring you Steve Mehew with his amazing disk editor in the latest installment to find this year's most talented programmer.

PROGRAMMER OF THE YEAR

commodore

WELL, IT DOES SEEM THAT 64 machine coders are into utilities. Steve Mehew of Strathhaven in bonnie Scotland supplied this month's entry – an all-singing, all-disassembling disk editor. His program lets you read in, examine and alter any sector of a 1541 disk. It's got a lot of bells and whistles... you can disassemble any machine code in a sector, change the data in decimal, hex of ASCII, dump to a CBM printer or a Centronics printer on the user port and ...well, try it for yourself!

The program has all sorts of uses...fixing damaged files, recovering erased ones, altering the disk title and so on.

Loaded Questions

Of course, getting a professional utility like this going means a bit of typing on your part. The program is around 6½K of machine code in two parts.

To enter the two programs you need to have entered the machine code entry program to be found elsewhere in this issue. Follow the instructions provided with the loader program. ED1 should be saved from 28160 to 32767. ED2 should be saved from 49152 to 51239.

Mini-Manual

Steve's Disk Editor is so easy to use you'll hardly need instructions. However, just to get you started, we've provided a diagram showing the screen layout and this list of commands. All the commands are single key presses and any further options are prompted for on the screen.

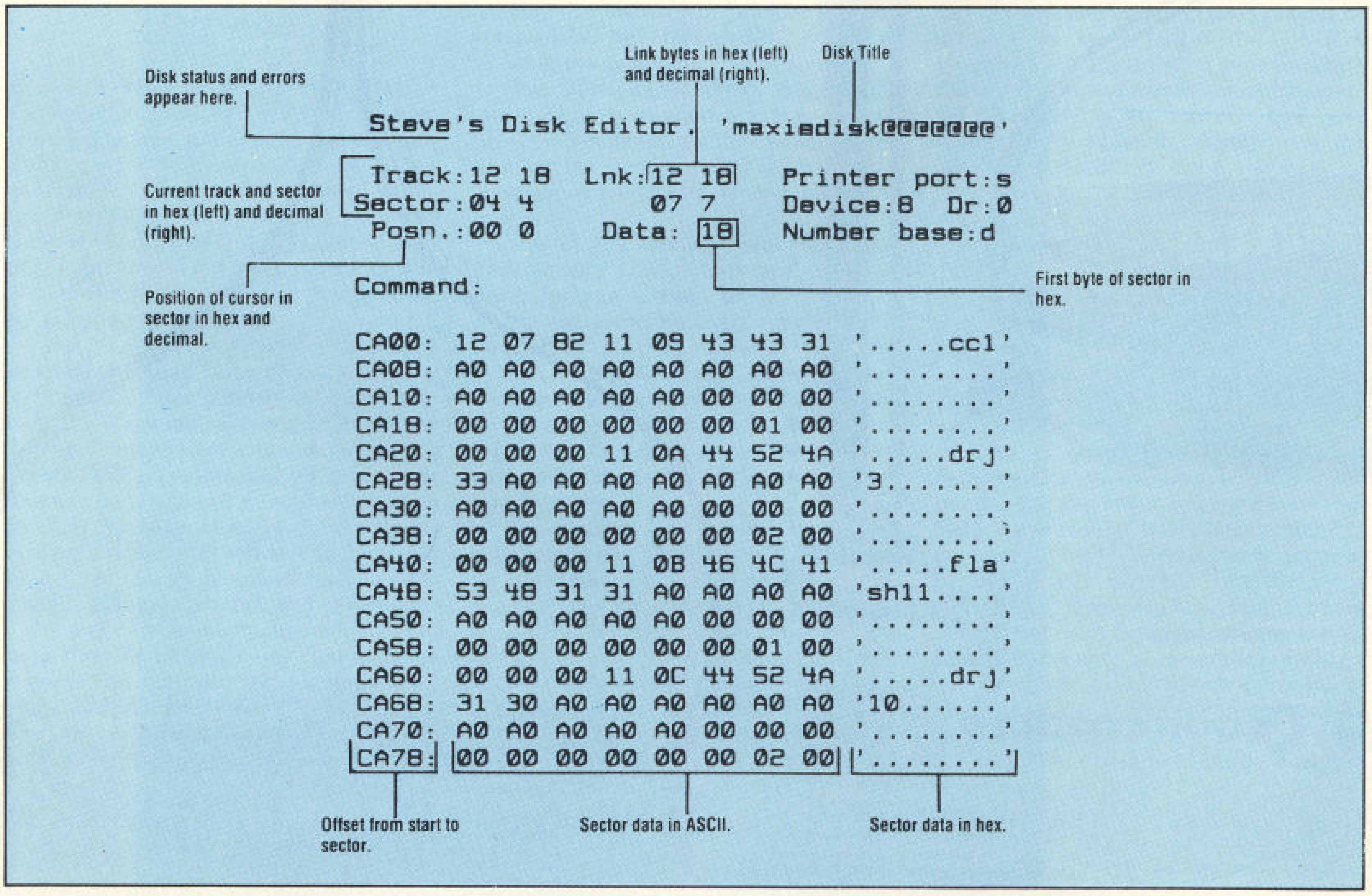
Steve's Disk Editor At Work

Here's a sample screen showing the editor at work. We've labelled some of the info – the other bits should be obvious when you use the program!

Disk Editor Boot

Enter and save this little program – it starts the disk editor going. However, you'll need to use the Basic Loader and the ED1 and ED2 listings to create the ED1 and ED2 files on your disk first!

```
10 REM[SPC3]STEVE'S DISK EDITOR LOADER
20 REM[SPC4](C) STEVE MEHEW NOV 1984
30 REM
40 C=C+1:IF C=1 THEN POKE 53280,0:POKE 53281,0:PRINT CHR$(147)
50 IF C=1 THEN PRINT"LOADING 'ED1'...":LOAD "ED1",8,1
60 IF C=2 THEN PRINT"LOADING 'ED2'...":LOAD "ED2",8,1
70 SYS 28160:REM START EDITOR
```



Reading and Writing Sectors

COMMAND	COMMENT
C	Specify the track and sector to read in
+	Read in the next sector
-	read in the previous sector
N	move to the next track
P	move to the previous track
F7	Follow link. The first two bytes of every sector in a file give the track and sector number of the next sector in the file. Pressing F7 follows this link allowing you to quickly scan through files.
R	Re-read sector. If you've made a mess of editing this key re-reads the current sector allowing you to try again.
W	DANGER! This command writes an edited sector back to the disk, destroying the sector that was there. Use it only when you are sure your edited sector is correct!

Editing Commands

Arrow keys	move the cursor around the sector data
HOME	place the cursor at the start of the sector data
F3	switch between the first and second half of the sector data – only 128 bytes on screen at once.
V	edit the sector data by entering a series of numbers in decimal or hex
T	edit the sector data by entering a string of up to 26 characters
A	disassemble machine code in the sector starting at the cursor position.
E	exclusive-Or the whole buffer with the number specified.

Other Commands

F2	Init drive. Use this if you've taken the disk out or changed to a different disk.
H	display help page.
D	dump screen to printer
F5	normal disk directory
B	toggle number base between decimal and hex
F4	toggle between drives 0 and 1 - for 4040 or similar drives only
F6	Increment device number. Allows you to edit disks in drives with different device numbers such as a second 1541 drive.
F1	Toggle printer port between a normal CBM printer on the serial bus (s) and a Centronics-type printer on the user port(u).
F8	Quite program. You can restart the disc editor if it hasn't been overwritten with SYS 28160.

ED1 Listing

```
28160:076 175 111 068 069 086 069 076 079 080 077 069 011
28172:078 084 032 068 073 083 075 064 064 152 141 167 069
28184:002 032 032 110 138 141 167 002 074 074 074 074 176
28196:032 044 110 173 167 002 041 015 248 024 105 144 117
28208:105 064 216 201 058 144 002 009 128 076 022 231 024
28220:141 167 002 076 032 110 201 032 144 017 201 094 253
28232:144 010 201 219 176 009 201 193 144 005 041 223 102
28244:076 022 231 169 046 076 022 231 169 015 133 190 184
28256:169 202 133 252 165 065 240 010 169 000 024 105 094
28268:128 133 251 076 118 110 169 000 133 251 032 222 195
28280:110 162 000 032 201 255 162 008 160 000 024 032 242
28292:010 229 169 014 141 134 002 166 251 164 252 032 160
28304:021 110 169 058 032 022 231 169 032 032 022 231 249
28316:160 000 177 251 032 060 110 169 032 032 022 231 152
28328:200 192 008 208 241 169 039 032 022 231 160 001 135
28340:132 212 136 177 251 032 066 110 200 192 008 208 112
28352:246 169 039 032 022 231 169 000 133 212 198 190 041
28364:048 010 165 251 024 105 008 133 251 076 139 110 244
28376:169 255 141 013 220 096 169 127 141 013 220 096 084
28388:147 159 014 008 005 017 017 032 032 032 032 032 243
28400:032 032 032 032 032 211 084 069 086 069 039 083 017
28412:032 196 073 083 075 032 197 068 073 084 079 082 046
28424:013 032 032 032 032 032 032 032 032 032 032 163 248
28436:163 163 163 163 163 163 163 163 163 163 163 163 184
28448:163 163 163 163 163 163 013 013 013 013 032 032 102
28460:032 032 032 032 032 032 032 195 079 080 089 082 025
28472:073 071 072 084 032 211 084 069 086 069 032 205 120
28484:069 072 069 087 013 013 032 032 032 032 032 032 071
28496:032 032 032 032 032 032 032 206 079 086 069 077 053
28508:066 069 082 032 049 057 056 052 013 013 013 013 095
28520:032 032 032 032 032 032 032 032 032 197 078 083 238
28532:085 082 069 032 049 053 052 049 032 073 083 032 039
28544:065 067 084 073 086 069 013 017 017 017 032 032 188
28556:032 032 032 032 208 082 069 083 083 032 018 032 107
28568:211 208 193 195 197 032 146 032 084 079 032 080 105
28580:082 079 067 069 068 069 046 046 046 013 000 162 143
28592:000 189 228 110 240 006 032 022 231 232 208 245 127
28604:141 032 208 141 033 208 169 008 141 175 002 169 079
28616:005 133 151 169 008 133 150 165 197 201 060 208 244
28628:250 169 000 133 198 032 234 113 032 241 111 032 221
28640:041 114 162 255 154 032 197 112 032 252 117 032 188
28652:115 118 076 226 111 169 147 032 022 231 169 000 116
28664:141 032 208 141 033 208 169 006 141 134 002 162 089
28676:000 189 030 112 240 006 032 022 231 232 208 245 015
28688:162 008 160 000 024 032 010 229 032 092 110 076 183
28700:138 113 018 211 084 069 086 069 039 083 032 196 142
28712:073 083 075 032 197 068 073 084 079 082 046 032 196
28724:039 032 032 032 032 032 032 032 032 032 032 032 187
28736:032 032 032 032 032 039 032 013 018 032 212 082 140
28748:065 067 075 058 032 032 032 032 032 032 032 204 001
28760:078 075 058 032 032 032 032 032 032 032 032 208 251
28772:082 073 078 084 069 082 032 080 079 082 084 058 215
28784:032 018 211 069 067 084 079 082 058 032 032 032 140
28796:032 032 032 032 032 032 032 032 032 032 032 032 252
28808:032 032 032 032 196 069 086 073 067 069 058 032 146
28820:032 032 196 082 058 032 018 032 208 079 083 078 054
28832:046 058 032 032 032 032 032 032 032 032 196 065 013
28844:084 065 058 032 032 032 032 032 032 206 085 077 171
28856:066 069 082 032 066 065 083 069 058 032 032 013 083
28868:000 162 002 160 007 024 032 010 229 169 001 133 101
28880:199 169 006 141 134 002 165 057 032 060 110 056 059
28892:032 010 229 160 010 024 032 010 229 166 057 169 068
28904:000 032 205 189 032 226 113 162 003 160 007 024 105
28916:032 010 229 165 058 032 060 110 056 032 010 229 243
28928:160 010 024 032 010 229 166 058 169 000 032 205 071
28940:189 032 226 113 162 002 160 018 024 032 010 229 185
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28952:165 060 032 060 110 056 032 010 229 160 021 024 215
28964:032 010 229 166 060 169 000 032 205 189 032 226 106
28976:113 162 003 160 018 024 032 010 229 165 059 032 031
28988:060 110 056 032 010 229 160 021 024 032 010 229 009
29000:166 059 169 000 032 205 189 032 226 113 162 002 147
29012:160 039 024 032 010 229 173 178 002 032 210 255 148
29024:162 003 160 033 024 032 010 229 174 175 002 169 245
29036:000 032 205 189 169 032 032 210 255 056 032 010 050
29048:229 160 039 024 032 010 229 174 174 002 169 000 082
29060:032 205 189 076 177 113 162 000 160 022 024 032 044
29072:010 229 169 001 133 199 169 006 141 134 002 162 219
29084:000 160 001 132 212 189 003 110 032 022 231 232 200
29096:224 016 208 245 169 000 133 199 096 162 004 160 248
29108:038 024 032 010 229 165 063 032 210 255 162 004 124
29120:160 007 024 032 010 229 165 002 032 060 110 056 055
29132:032 010 229 160 010 024 032 010 229 169 000 166 251
29144:002 032 205 189 032 226 113 076 096 122 169 032 230
29156:032 210 255 076 210 255 162 001 134 058 162 018 009
29168:134 057 162 001 134 060 134 059 162 000 142 174 179
29180:002 134 002 134 065 169 008 141 175 002 169 085 058
29192:141 178 002 169 068 133 063 169 048 141 112 114 066
29204:162 017 169 064 157 003 110 202 016 250 169 173 232
29216:141 000 003 169 126 141 001 003 096 169 002 160 019
29228:114 162 111 032 189 255 169 015 174 175 002 168 074
29240:032 186 255 032 192 255 176 049 162 015 032 198 104
29252:255 162 001 160 000 024 032 010 229 169 000 133 219
29264:199 032 207 255 201 013 240 006 032 210 255 076 014
29276:081 114 032 124 117 032 138 113 169 018 133 057 196
29288:169 000 133 058 076 253 118 073 048 162 000 189 103
29300:127 114 240 006 032 022 231 232 208 245 096 019 152
29312:017 197 082 082 079 082 032 087 073 084 072 032 023
29324:196 201 211 203 032 067 079 077 077 085 078 073 239
29336:067 065 084 073 079 078 046 046 046 032 032 032 064
29348:032 032 032 000 162 000 134 212 032 201 255 169 145
29360:001 141 134 002 169 147 032 210 255 169 242 133 019
29372:251 169 114 133 252 160 000 177 251 240 012 032 187
29384:022 231 230 251 208 002 230 252 076 195 114 165 128
29396:197 201 018 240 006 201 060 208 246 240 006 032 075
29408:053 125 076 211 114 169 000 133 198 032 241 111 151
29420:032 138 113 076 197 112 032 032 032 032 032 032 072
29432:032 032 032 032 211 084 069 086 069 039 083 032 025
29444:196 073 083 075 032 197 068 073 084 079 082 013 035
29456:032 032 032 032 032 032 032 032 032 032 045 045 170
29468:045 045 045 045 045 045 045 045 045 045 045 045 056
29480:045 045 045 045 045 013 032 032 032 032 032 195 121
29492:032 032 211 080 069 067 073 070 089 032 078 069 186
29504:087 032 084 082 065 067 075 032 038 032 083 069 042
29516:067 084 079 082 013 032 032 032 032 032 043 032 124
29528:032 206 069 088 084 032 083 069 067 084 079 082 039
29540:013 032 032 032 032 032 206 032 032 206 069 088 138
29552:084 032 084 082 065 067 075 013 032 032 032 032 230
29564:032 045 032 032 208 082 069 086 073 079 085 083 006
29576:032 083 069 067 084 079 082 013 032 032 032 032 005
29588:032 208 032 032 208 082 069 086 073 079 085 083 193
29600:032 084 082 065 067 075 013 032 032 032 032 032 226
29612:215 032 032 215 082 073 084 069 032 083 069 067 201
29624:084 079 082 013 032 032 032 032 198 055 032 032 119
29636:198 079 076 076 079 087 032 076 073 078 075 013 114
29648:032 032 032 032 032 210 032 032 210 069 045 082 024
29660:069 065 068 032 083 069 067 084 079 082 013 032 195
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29684:032 078 085 077 069 082 073 067 065 076 032 068 024
29696:065 084 065 013 032 032 032 032 032 212 032 032 151
29708:197 078 084 069 082 032 084 069 088 084 013 032 156
29720:032 032 032 198 056 032 032 209 085 073 084 032 153
29732:080 082 079 071 082 065 077 013 032 032 032 032 201
29744:198 051 032 032 212 079 071 071 076 069 032 198 145
29756:201 210 211 212 047 211 197 195 207 206 196 032 137
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29780:032 032 196 073 082 069 067 084 079 082 089 013 214
29792:032 032 032 032 032 194 032 032 212 079 071 071 179
29804:076 069 032 078 085 077 066 069 082 032 066 065 137
29816:083 069 013 032 032 032 032 198 052 032 032 212 171
29828:079 071 071 076 069 032 068 082 073 086 069 013 153
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29852:073 065 076 073 090 069 032 068 082 073 086 069 244
29864:013 032 032 032 032 198 054 032 032 201 078 067 203
29876:082 069 077 069 078 084 032 196 069 086 073 067 138
29888:069 032 035 013 032 032 032 032 032 196 032 032 249
29900:196 085 077 080 032 083 067 082 069 069 078 032 130
29912:084 079 032 080 082 073 078 084 069 082 013 032 236
29924:032 032 032 198 049 032 032 212 079 071 071 076 120
29936:069 032 080 082 073 078 084 069 082 032 080 079 056
29948:082 084 013 032 032 200 207 205 197 032 032 195 027
29960:085 082 083 079 082 032 084 079 032 080 079 083 120
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29996:083 069 077 066 076 069 032 070 082 079 077 032 088
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30020:197 032 032 197 088 067 076 085 083 073 086 069 129
30032:032 207 210 032 066 085 070 070 069 082 013 032 024
30044:213 083 069 032 067 085 082 083 079 082 032 075 050
30056:069 089 083 032 084 079 032 077 079 086 069 032 147
30068:067 085 082 083 079 082 046 000 169 001 160 117 063
30080:162 251 032 189 255 169 002 168 174 175 002 032 203
30092:186 255 032 192 255 162 015 032 201 255 032 186 151
30104:117 032 204 255 162 015 032 201 255 032 200 117 238
30116:162 000 032 201 255 162 002 032 198 255 032 237 196
30128:117 162 000 032 198 255 032 201 255 096 162 000 150
30140:189 214 117 240 006 032 210 255 232 208 245 096 184
30152:162 000 189 227 117 240 006 032 210 255 232 208 030
30164:245 096 066 045 082 058 050 044 048 044 049 056 071
30176:044 048 000 066 045 080 058 050 044 049 052 052 044
30188:000 162 000 032 207 255 157 003 110 232 224 016 098
30200:208 245 096 035 162 006 160 000 024 032 010 229 175
30212:169 000 133 199 133 212 162 000 189 049 118 240 072
30224:006 032 022 231 232 208 245 162 006 160 008 024 072
30236:032 010 229 032 101 118 096 040 067 041 083 084 193
30248:069 086 069 032 077 069 072 069 087 195 079 077 253
30260:077 065 078 068 058 032 032 032 032 032 032 032 110
30272:032 032 032 032 032 032 032 032 032 032 032 032 192
30284:032 032 032 157 157 157 157 157 157 157 157 157 049
30296:157 157 157 157 157 157 157 157 157 157 157 157 180
30308:000 169 000 133 204 032 228 255 201 000 240 249 019
30320:133 204 096 141 181 002 201 072 208 003 076 168 061
30332:114 162 000 189 141 118 240 008 205 181 002 240 188
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30344:086 232 208 243 096 019 072 067 043 078 082 087 169
30356:136 084 086 045 080 140 135 134 066 137 017 145 073
30368:029 157 138 139 068 133 065 069 000 049 127 168 022
30380:114 054 121 017 120 247 119 253 118 124 119 105 147
30392:120 201 124 119 124 073 120 005 120 240 118 037 049
30404:123 231 119 175 120 162 120 063 122 165 122 201 127
30416:122 247 122 116 120 141 120 053 125 030 126 032 026
30428:127 177 127 138 010 170 189 169 118 133 251 232 013
30440:189 169 118 133 252 108 251 000 169 002 032 195 058
30452:255 169 015 032 195 255 076 226 252 162 015 032 136
30464:201 255 162 000 189 120 119 240 006 032 210 255 253
30476:232 208 245 162 002 169 000 032 205 189 032 154 106
30488:119 169 000 174 174 002 032 205 189 032 154 119 113
30500:169 000 166 057 032 205 189 032 154 119 169 000 048
30512:166 058 032 205 189 032 204 255 162 039 169 032 055
30524:157 040 004 202 016 250 173 181 002 201 009 208 223
30536:001 096 162 015 032 198 255 160 000 162 001 024 154
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30560:013 240 006 032 022 231 076 092 119 032 163 119 217
30572:162 000 032 198 255 032 201 255 032 204 255 096 038
30584:085 049 058 000 032 204 255 032 031 125 162 015 144
30596:032 201 255 162 000 189 159 119 240 006 032 210 201
30608:255 232 208 245 032 015 119 076 253 118 169 044 118
30620:076 210 255 085 050 058 000 032 204 255 032 198 075
30632:119 162 002 032 198 255 162 000 032 207 255 157 213
30644:000 202 232 208 247 173 000 202 133 060 173 001 019
30656:202 133 059 076 092 110 032 204 255 162 015 032 028
30668:201 255 162 000 189 223 119 240 006 032 210 255 049
30680:232 208 245 032 204 255 096 066 045 080 058 050 251
30692:044 048 000 165 002 024 105 128 133 002 165 065 085
30704:073 001 133 065 076 092 110 166 057 232 224 036 225
30716:208 002 162 001 134 057 076 253 118 166 057 202 152
30728:016 002 162 035 134 057 076 253 118 230 058 166 035
30740:057 189 037 120 197 058 144 003 076 253 118 169 161
30752:000 133 058 076 247 119 020 020 020 020 020 020 017
30764:020 020 020 020 020 020 020 020 020 020 020 018 026
30776:018 018 018 018 018 018 017 017 017 017 017 017 010
30788:016 016 016 016 016 198 058 016 013 166 057 202 090
30800:240 011 189 037 120 133 058 076 005 120 076 253 118
30812:118 162 035 189 037 120 133 058 134 057 076 253 184
30824:118 165 060 133 057 165 059 133 058 076 253 118 219
30836:173 174 002 073 001 141 174 002 174 174 002 189 115
30848:139 120 141 112 114 032 231 255 076 041 114 048 015
30860:049 238 175 002 173 175 002 201 012 208 005 169 013
30872:008 141 175 002 032 231 255 076 041 114 169 002 118
30884:032 195 255 169 015 032 195 255 076 041 114 165 172
30896:063 201 072 240 007 169 072 133 063 076 197 112 045
30908:169 068 133 063 076 197 112 134 066 169 000 141 236
30920:185 002 169 001 133 212 032 228 255 072 160 000 113
30932:132 204 132 207 132 212 160 001 132 212 104 240 032
30944:237 201 013 240 025 201 020 240 049 174 185 002 019
30956:157 000 002 032 210 255 238 185 002 173 185 002 141
30968:197 066 240 015 208 208 174 185 002 169 000 157 077
30980:000 002 160 000 132 212 096 056 032 010 229 136 045
30992:024 032 010 229 206 185 002 076 206 120 206 185 217
31004:002 048 017 169 032 032 028 234 056 032 010 229 149
31016:136 024 032 010 229 076 206 120 238 185 002 076 094
31028:206 120 162 006 160 000 024 032 010 229 162 000 139
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31040:189 091 121 240 040 032 022 231 232 208 245 048 227
31052:049 050 051 052 053 054 055 056 057 065 066 067 239
31064:068 069 070 197 078 084 069 082 032 206 197 215 175
31076:032 212 210 193 195 203 058 032 000 032 177 121 029
31088:165 064 133 057 076 210 121 000 001 002 003 004 180
31100:005 006 007 008 009 010 011 012 013 014 015 162 140
31112:000 189 075 121 197 159 240 003 232 208 246 189 203
31124:119 121 010 010 010 010 133 064 162 000 189 075 027
31136:121 197 158 240 003 232 208 246 189 119 121 024 226
31148:101 064 133 064 096 165 063 201 072 208 003 076 138
31160:018 122 032 069 127 173 000 002 201 160 240 013 061
31172:169 000 133 122 169 002 133 123 032 158 183 134 018
31184:064 096 162 006 160 000 024 032 010 229 162 000 129
31196:189 255 121 240 006 032 022 231 232 208 245 032 241
31208:177 121 165 064 133 058 032 197 112 169 032 162 118
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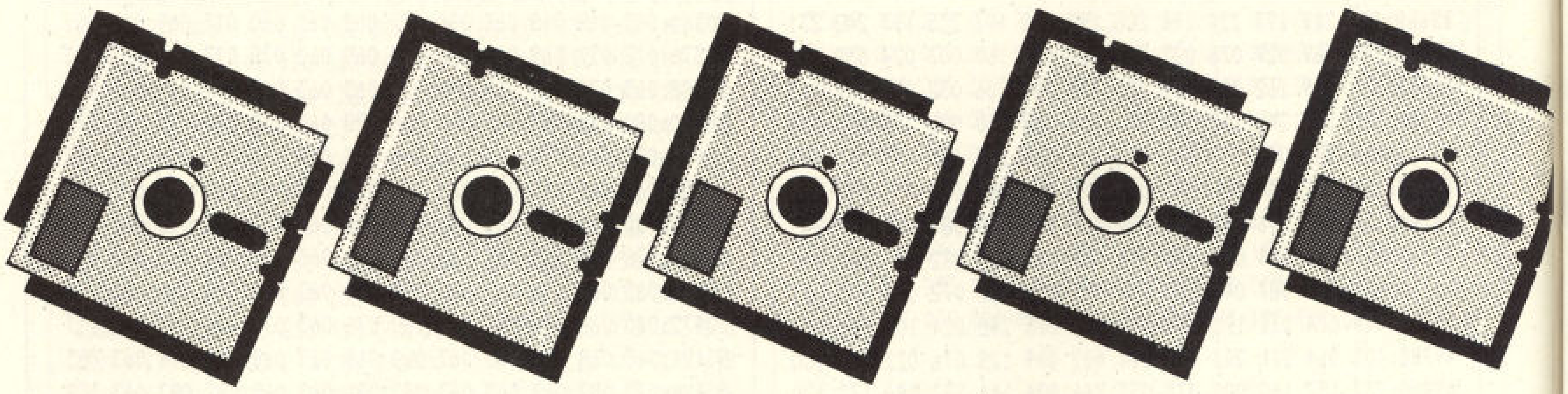
ED2 Listing

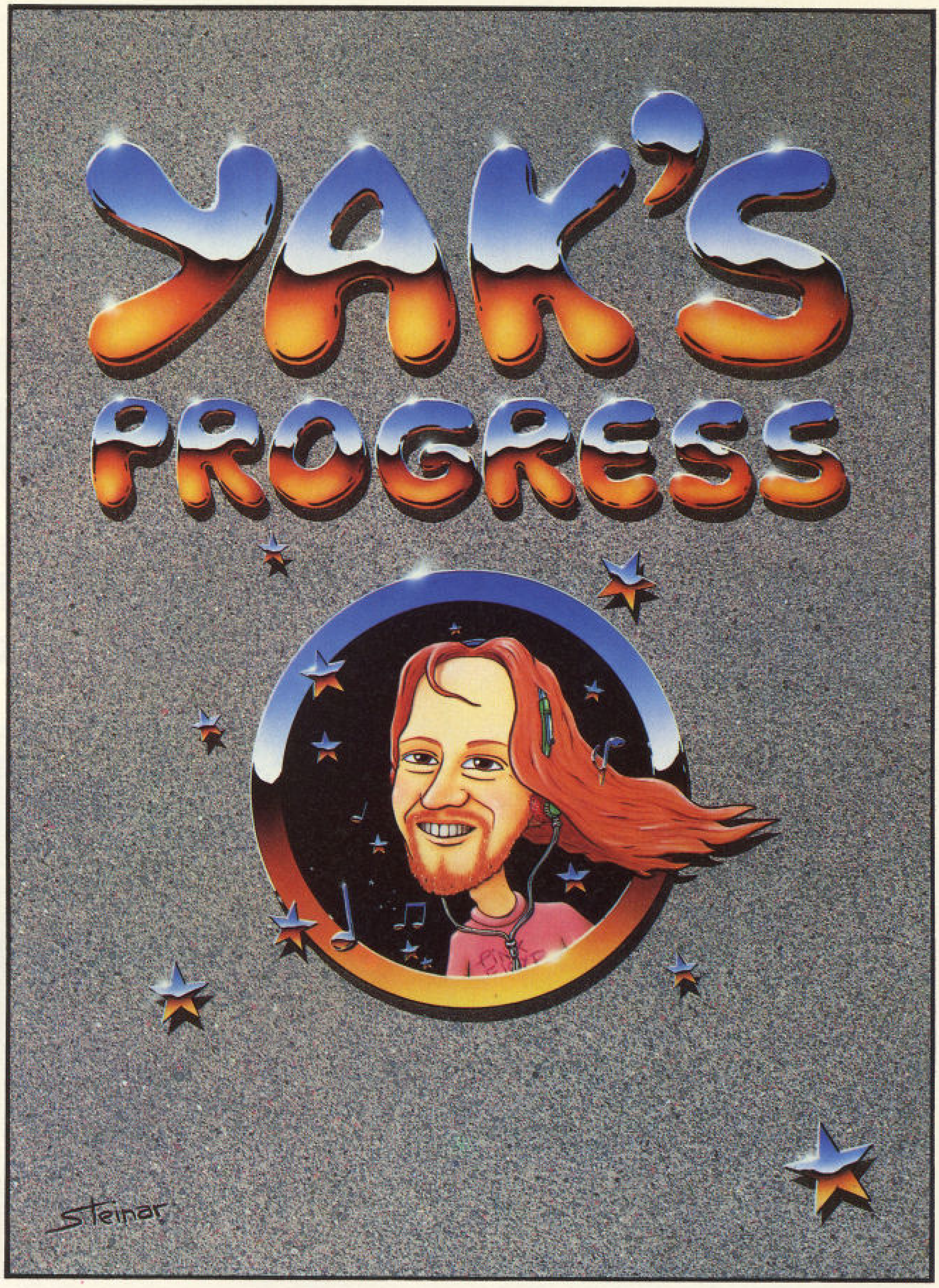
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GAME *of the month*

Peter Thomas has braved bullets and shellfire to bring you this review of US Gold's Crusade in Europe for the C64.

PREPARE FOR BATTLE! NO THIS IS NOT a quick, trigger-happy game, but a sophisticated, thought provoking, strategy game which I found highly entertaining and absorbing.

You play either the Allied or German Supreme Commander and control the fate of Europe in 1944. You can change the course of history from your own living room.

The game has five different scenarios. Each allows you to enter the battle for France at a different stage.

The first part is the battle for Normandy. The scene is set, June 1944. The war in Europe hangs in the balance. Three Elite paratroop regiments have been dropped in advance and the Allied infantry divisions have just landed and started moving in land. The Germans try to drive you back into the sea as reinforcements for both sides begin to arrive.

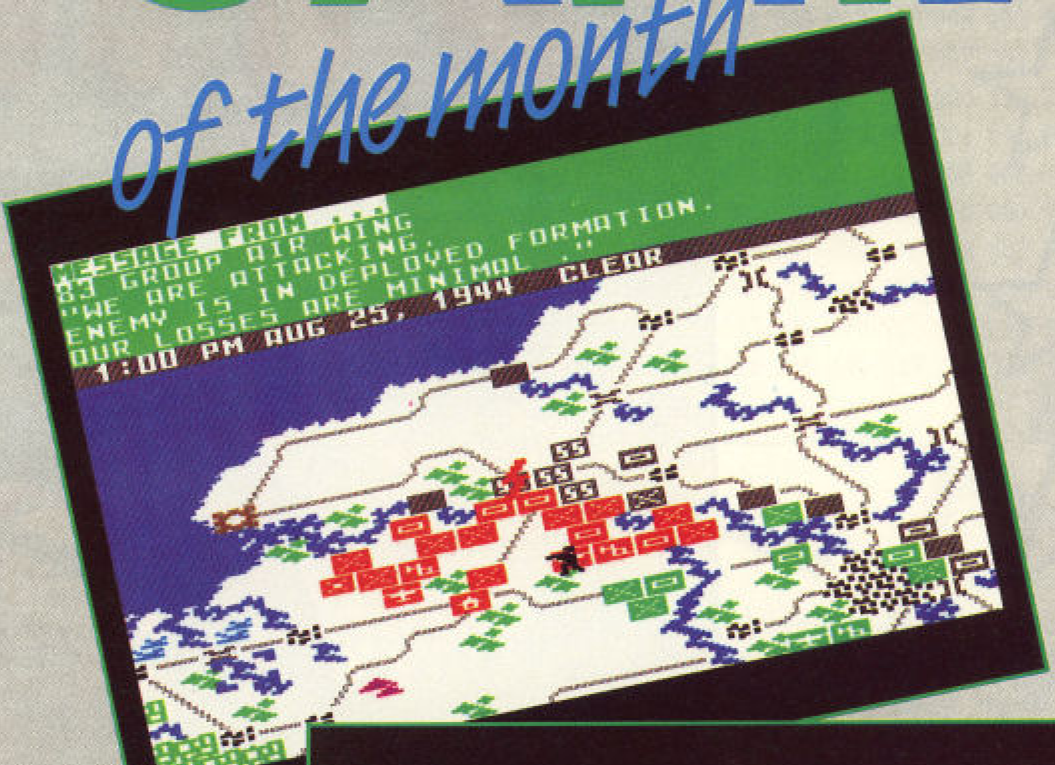
Choose which army you wish to command, then play a friend or pit your wits against the computer. You are allowed to alter the balance of play according to your experience.

Using a joystick or keyboard for control, you first freeze the action to allow you time to examine your troops, the opposition, survey the countryside and decide your strategy. Once you have formulated your plan of action you start giving your orders. You can order different units to attack, defend or move.

Will you decide to risk an all out offensive or dig in and wait for reinforcements to arrive? You make all the decisions, tap in your orders and watch the battle take place on the screen. But keep your eyes peeled as the enemy moves around and always be prepared to rethink your strategy.

At any time you may call up any units and receive a current status report. How many men are left? How experienced are they? What is their efficiency level? Do they need to be rested for a while? Can you spare them? You must decide all this.

As Supreme Commander you can never go to sleep because even at night the messages keep rolling in: "Attack must be halted", "Await further orders", "We have captured Paris", "Are supplies running out?". However you can freeze the action at any time if you are in need of refreshment or a stiff drink to calm your nerve endings! I recommend that you keep a spare disk handy so the current situation can be saved at any time.







The second part is the race for the Rhine. After liberating France the Allies rush towards the Rhine to secure the German borders, Belgium and Holland. Again there is a short and long variation.

The scrolling screen allows you to have an overall picture of the battle as it progresses. Also the computer constantly tells you the present date, time and weather conditions.

The graphics are extremely realistic and the battle is easy to follow. The sound effects make the war come to life – the volume level of each attack indicates how much damage is being inflicted on the opposition.

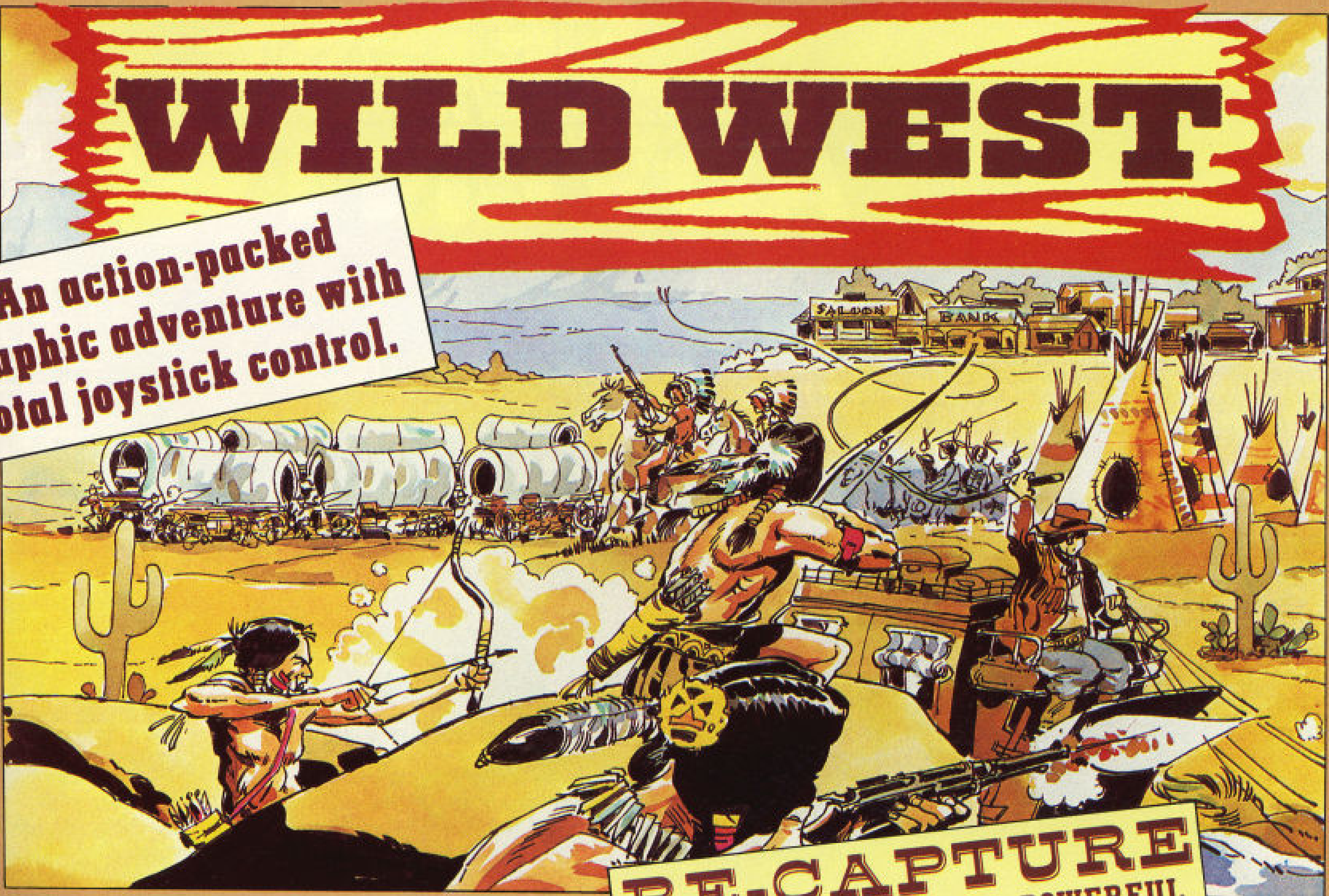
Operation Market Garden is the next section which allows you to control Hitler's crack SS Panzer troops in a last desperate bid to split the British and American armies and force them back into the sea. Can you succeed where Hitler failed? Or will the snowy, wintry conditions overcome your offensive?

The final Crusade for the Battle for France is the big one. Start from the landing of the troops in Normandy, secure a beach head, push the Germans backwards as you liberate Paris and then race across France and Belgium to the German borders.

This program has many interesting features. At any time you can press "?" to receive an up-to-date status report on how many casualties have been sustained by each side and who is currently winning. And, at the end of each section, you will be awarded a final rank for your performance ranging from Private to Supreme Commander.

Even if you have no previous experience of strategy games, I strongly recommend you buy Crusade in Europe – you won't be disappointed.

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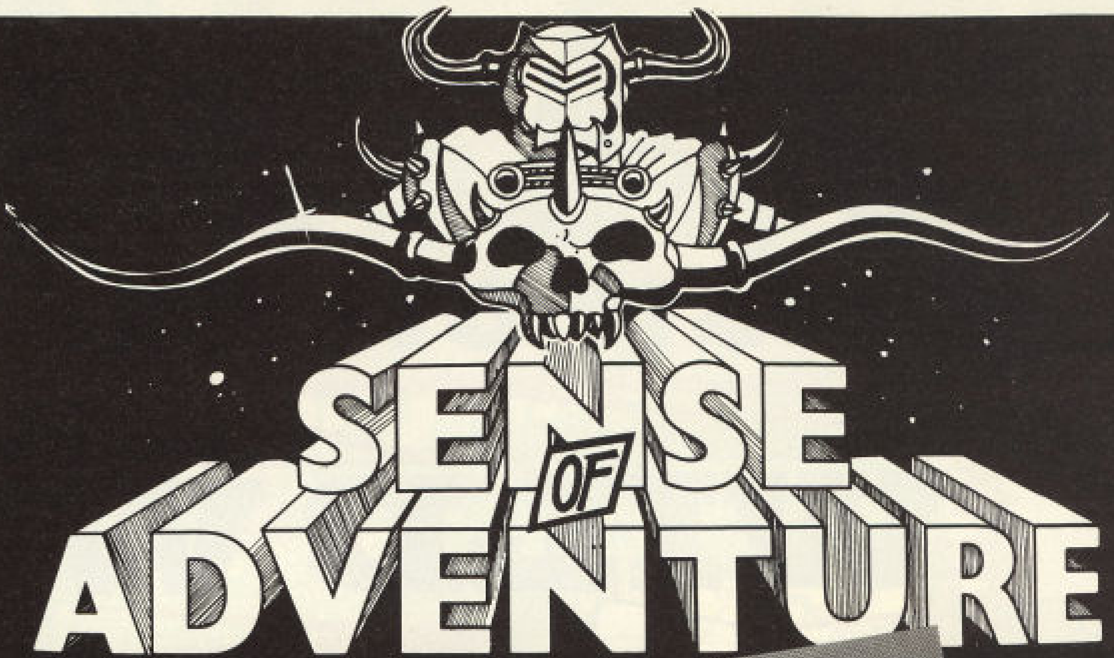
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Runecaster has donned his Lincoln Green outfit to have a closer look at Robin and his merry men in the wilds of Sherwood forest.

Forestry Lesson

WHAT IS YOUR APTITUDE FOR TREE recognition? Can you track someone through the wilds of Sherwood Forest? Perhaps you need not be too hot on beeches and birches but some form of pattern recognition comes in helpful once you get into *Robin of Sherwood* – Adventure International's latest graphics adventure for the C64.

Being an avid follower of the TV series, I wondered if the computer game would be a big let down. The answer, fortunately, is quite a big no. Adventure International has built up a fair reputation for its games and this one certainly can be favourably compared with past successes.

Robin takes about six minutes to load, which is quite a long time when you realise that a fast loader has been incorporated...possibly they have gone for a slower 'fast load' to overcome some of the loading problems encountered by some companies who use 'super fast loaders'!

The review copy loaded without a hint of a glitch and six minutes is not very long to wait anyway...loading in the data from a previously saved game is fast – about 25 seconds. This is a useful facility, as all the interesting options initially presented by the game as your progress unfolds...seem to end in disaster!

The graphics are good and for the most part are very clear with the impression of good detail. They are 'drawn' on the screen very quickly, which is a good thing because you can't turn them off!

I am not a wholehearted supporter of graphics with everything, I would usually prefer that the effort had gone into the text and implementation of the game play. Here, I have to admit that the visual impression is pleasing and certainly does not detract from the business of adventuring!

Once loaded, your first task is to get Robin and his merry men (not so merry at this moment, and only two of them!) out of the dungeon at Nottingham Castle. For those that get fed up with trying to do this the hard way – the instruction leaflet reveals all...well almost all!

You may feel slightly frustrated for a few minutes but persevere and don't forget to examine things/people as you progress! Having escaped from the dungeon, you now have to get out of the castle.



In conquering this first little puzzle, you will already have started to 'feel out' how Adventure International has set up the input command interpreter. You do not have to 'OPEN DOORS' and then move through them, all that is needed is 'GO DOOR' and the rest follows naturally.

If you apparently cannot move to a certain object or place, try 'GO XXXX' you may achieve the desired result. You must also determine what is and is not understood and what sort of response you get in each case.

Some programs will indicate if they do not recognise a word. This one ignores them completely. Beware of giving an instruction and believing that it has been carried out because there was no response to the contrary!

Even though only the first four letters of a word are necessary for the program to know what you are talking about – check that your spelling is correct. 'EXAM PRRIS' instead of 'EXAM PRIS' (examine prisoners) will elicit the standard response 'that nothing special is seen' and examining things is important!

If you saw *Robin of Sherwood* on the box, you are at a slight advantage, as all of the events portrayed in this adventure are related to various episodes and places seen in the series. Although, as I have not yet solved all of the problems set, there may be a few twists that I haven't yet come across.

The game certainly does not require a knowledge of the TV plots, so if you do not have that feeling of 'deja vu' just enjoy solving a series of logical puzzles that have to be completed in the correct sequence.

Once out of the castle you will come face to face with Herne the Hunter. He will tell you that it is your task to find the six Touchstones of Rhiannon and then return them to their rightful place.

A touchstone was used to test the purity of gold or silver but I doubt whether this small gem of information will help you very much!

Once you have left Herne you find (or lose!) yourself deep in Sherwood Forest. There are 53 locations that have a description saying that you are in the forest – and nothing else!

Panic not. Just reach for your pencil and paper, all is not quite the maze it first appears – hence the earlier reference to pattern recognition.

Around about and here and there, you will find various places that obviously call out for a more careful study and of course

herein lies the crux of the game. Odd bods appear from time to time and some of these may be requested to follow Robin and lend much needed aid at critical moments.

As the sequence of events is important it is wise to 'save' your progress at various different points – in case you later find you need to tackle things in a different order.

Altogether an enjoyable game that should keep beginner and expert out of mischief and pleasantly frustrated for some time.

Old But Fun

US Gold has added to its range of adventures available in the UK by releasing C64 versions of two games that have been around for some time on other machines. The first of these *Wizard and the Princess* was seen on the Atari several years ago and shows its age by the simple input command analyser.

The storyline is pretty thin – wicked wizard kidnaps fair princess...hero needed to rescue same! The slightly whacky twist is more in the instructions than in the game: The wizard as narrator, bemoans the fact that previous heroes have beaten him and that he hopes to do better against you!

Inputs are expected as just two words – verb/noun. In some ways this poses less problems to the user than some of the more modern complex analysers. Providing you have the right two words, there is no frustration trying to get the order and syntax correct!

Of course getting the right words can still take time! The vocabulary in adventure games is gradually becoming somewhat of a standard feature these days so EXAMINE is part of the player's normal armoury. This is one of the slight differences you will notice with *Wizard and the Princess*. Here you must use LOOK.

You must also literally restrict yourself to two words. The program does not automatically disregard such words as A, TO or THE. It is surprising how even in the less complex games today how much progress is overlooked!

The program is available on disk only, and uses it all the time. Nearly every input command has the disk unit whirring away, checking something, or reading in new data. Each location has its own graphics, these are colourful and very clear but use fairly simplistic designs.

One point that I found slightly frustrating was that all words had to be entered in full to be recognised...lazy, that's me! A save game facility is implemented by using a separate disk (not supplied!). As death occurs regularly whilst you suss out the problems before you, this is a definite plus point!

Text is kept to a fairly low level with many of the clues occurring within the pictures themselves, even if you do need a little imagination sometimes to associate that red blob as a rock!

Most of the puzzles, once solved, make you want to kick yourself for not having seen them earlier...always a good sign in an adventure game. The action is subdivided into a number of separate scenarios, each of which needs to be completed before you can move on to the next. Make sure you have done all that can be done before you move on!

With the low amount of information presented as text and the simple graphics, the actions of the player would seem to be somewhat limited. This may seem to be a good thing for beginners but my feeling is that they may become bored and a little frustrated, whereas the more experienced adventurer will probably have a little more 'stamina' and be prepared to ferret away at each location trying to find the anomaly that is the vital clue.

Wizard and the Princess is unlikely now to challenge the leaders in the adventure games world but it presents a good challenge to the players' observation and use of limited syntax and vocabulary.

Classic Aberration

The second release from US Gold is *Ulysses and the Golden Fleece*. I always thought that it was Jason that got involved with this particular hearth-rug but then perhaps there is a copyright problem with some of Virgil's descendants!

This program is presented in a very similar manner to that above, with limited text, simple but descriptive graphics and on disk only. The graphics seem to have had a little more work done on them and the full use of the Commodore's colours makes even these cartoon like pictures come to life.

The story is as you would expect, Ulysses must equip his ship and crew... sail off... avoid various lethal hazards... and return with the fleece, to present to the king.

The initial scenario allows for more manoeuvring than *Wizard and the Princess* so beginner adventurers may feel more inclined to persevere. Save your position fairly often once you have solved the first few puzzles, as death is never far away.

The dangers you will meet are varied, ranging from storms at sea to angry gods. Your memories of Greek myths may help a bit but some of the puzzles are quite subtle so keep a weather eye open all the time...observe and observe again.

Observation Plus

Whether *Hacker* from Activision will go down as an adventure or not, time will tell. It has all the hallmarks to suggest that it should, as, for instance, there are no instructions. You have to find out what it's all about yourself!

Just a few words could make it more interesting to play, though. The leaflet (I nearly said instructions!) implied that the player has hacked – accidentally – into an unknown computer system. From there on in... well, observation and a handy paper and pencil are paramount.

I appeared to be controlling some mega-powerful machine, cruising around beneath the surface of the earth (what for?). Power is the watchword, power to dominate the world – but am I a goody or a baddy? Do I assist the machine or foul it up and if so, how?

The system recognises there has been a security leak... and not me either. It starts asking awkward questions about what has been displayed on the screen a few minutes ago. I hope you've got a photographic memory with total recall. I haven't!

After the fifth or sixth attempt I had to call it a night even with paper and pencil ready, and willing to note down any pertinent facts. Starting from the beginning every time I failed to remember some vital detail and it all became just too much of a chore...

If only I knew what it was I was doing down there under the earth – other than passing time between awkward questions. I shall watch the top 10 charts with anticipation and hopefully memory!

Top 10s

A number of mags publish lists of top 10s, these are derived in several different ways. Some are from particular distributor's sales to their outlets. Some are from inputs from the readers themselves. If you sit down and think about it, sales could be merely a reflection of how good the advertising hype was for that particular product and not how good an adventure it is!

What adventures 'turn you on'? My top 10 would include the following; *The Zork Trilogy* by Infocom, several of the Level Nine adventures, *Exodus: Ultima III* from US Gold, *The Hobbit* by Melbourne House, one or two from Adventure International, *Witch's Cauldron* by Mikro-Gen, *The Lords of Midnight* from Beyond, something from Interceptor Micros and for pure wonder of animation – *Impossible Mission* from US Gold.

Yes, I know that gives us more than 10 but which would you choose? Write in and let me know, perhaps I'm missing out on something – or my memory is failing! Make sure you address any letters to 'Runecaster', Your Commodore etc. The editor has enough correspondence to open without giving him any extra!

Teacher's Pet

This month Margaret Webb examines Paint Boxes.

LAST MONTH I LOOKED AT THE MUSICal software available for the C64 – the computer equivalent to a Christmas stocking drum set. This month, I will describe a non-messy approach to paint boxes. Those of you with children will have discovered the never ending appeal of pens, paint and colouring books. The main problem, however, is the mess generated. I shall not recount the number of times I've found felt tip pen stains on my children's bedding!

As with the musical packages, there are a wide range of products which cater for all sizes of purse. These range from the very cheap and simple software to more expensive software/hardware packages.

The majority of the packages that I will describe are drawing programs. Two however are rather more like languages or Basic extensions.

There are two basic ways of creating graphics on the C64 and C-16. First we can build up pictures from the normal character set or from redefined characters. Only the Rolf Harris drawing program uses this approach. The second method is to use bit mapped mode. In this mode, individual pixels can be altered allowing the creation of complex curves and other shapes. Bit mapping is available in two modes. A high resolution mode allows only two colours in any one character space but permits highly detailed work. Multicolour mode supports four colours in any character space but gives slightly coarser results. Both have their uses and it's up to you to choose.

Since most of the sketching packages use the same or similar set of commands, I have compared them in the table and will only mention their peculiarities or useful features.

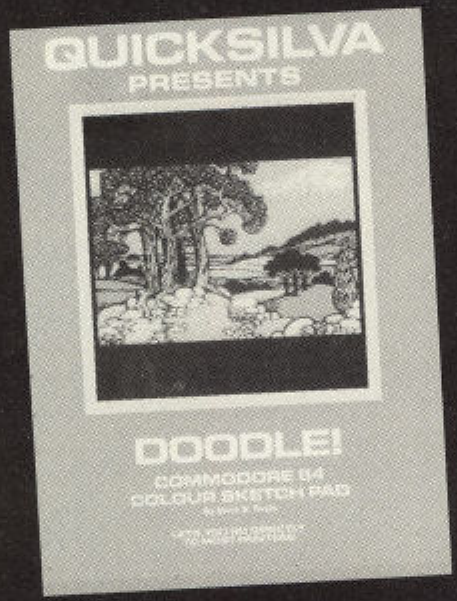
You may notice from the table that there is a core of commands which is common to most of the software. All programs, for instance, allow the drawing of dots, lines and circles. This is hardly surprising since these form the foundation for any sketch.

Before going into too much detail, I had better briefly describe the items listed in the table.

Mode relates to either high resolution or multicolour.

Points is a command for the control of individual pixels.

Line allows the drawing of a line between two specified points.



Rays involves the drawing of a number of lines, all with one end starting at the same point.

Box relates to the drawing of a quadrilateral by defining two opposite corners.

Circle as implied by its name draws a circle of specified size and position.

Ellipse is similar to circle and allows the drawing of elliptical shapes.

Arc allows the drawing of curves.

Fill/Paint colours in a drawn area in a specified solid colour.

Pattern fill is the same as fill but allows patterns.

Air Brush gives a sequence of controlled random dots and is useful for shading.

Screens; many packages provide more than one drawing area. This is useful for the copying and overlaying of designs.

Copy area copies a specified area of design to another area.

Move area moves a specified area.

Zoom magnifies an area of design to allow detailed drawing.

Oops allows you to correct errors or accidents made during drawing.

Brush; apart from providing thin lines, many packages provide patterned brushes for complex effects.

Mirror provides the means of making multiple drawings and kaleidoscope effects.

Text prints words on the picture.

Hard copy permits you to dump your drawing to a printer.

Save/Load means that you can save your masterpiece on disk or cassette.

Control; many packages use joystick or keyboard control.

Using the table and these brief comments, you can see how useful the packages are.

Three packages – *Koala Pad, Super Sketch* and *Magic Mouse* use hardware devices. The first two use drawing pads or tablets and the latter a mouse. As a consequence, they are quite expensive. *Magic Mouse* is a wider based utility and has weaker software. *Koala Pad* and *Super Sketch* are both very good products although *Super Sketch* is the better of the two.

Screen Graphics is a Basic extension and as such works very well. *Designer's Pencil* uses a language similar to LOGO and is a suitable means of introducing children to programming.

Of the high resolution packages, *Panorama* and *Doodle* are probably the most powerful. Both have great flexibility and are simple to use.

For the younger children, there are two packages available. The *Rolf Harris* package is easy to use and allows the building up of designs using the Commodore character set. In spite of this apparent limitation, the results possible are excellent – particularly in the C-16 version.

Ebury Software has a program called *Shape Games*. This product is part of the Mr T series and allows the creation of designs using the basic shapes. A second program called *Jigsaws* introduces the child to the basic shapes and encourages him to place the shapes in the correct position on the screen.

Publishers

Super Sketch (£49.95): Anirog, Unit 10, Victoria Industrial Park, Victoria Rd, Dartford DAI 5AJ

Koala Pad (£99.95): Audiogenic, PO Box 88, Reading, Berks

Paintbox (£9.95 both C64 and C-16): Audiogenic, 39 Suttons Industrial Park, London Rd, Reading

Panorama (£17.95): Curran Buildings, 101 St James Rd, Glasgow

Paint Pic : Kuma Computers, Unit 12, Horseshoe Park, Pangbourne, Berks

Doodle (£14.95): Quicksilva, 222 Regent St, London W1

Rolf Harris (both C64 and C-16): Commodore, 1 Hunters Rd, Weldon, Corby NN17 1QX

Magic Mouse (£59.95): Connexions, SMC Supplies, 11 Western Parade, Great North Rd, Barnett, Herts

Mr T Shape Games (£9.95): Ebury Software, National Magazine House, 72 Broadwick St, London W1V 2BP

Designer's Pencil (£11.99): Activision, 15 Harley House, Marylebone Rd, London NW1

	Doodle	Paint Pic	Koala Pad	Super Sketch	Panorama	Paintbox	Screen Graphics	Magic	Designers Pencil
Mode	H		M	M	H	H	H/M	M	M
Point	Y	Y	Y	Y	Y	Y	Y	Y	Y
Line	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rays			Y	Y		Y		Y	
Box	Y	Y	Y	Y		Y	Y	Y	
Circle	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ellipse	Y	Y		Y	Y				
Arc		Y							
Fill/Paint	Y		Y	Y	Y	Y	Y	Y	Y
Pattern Fill			Y	Y	Y				
Air brush								Y	
Screens	1	1	2	2	4	2		2	1
Copy area	Y	Y	Y	Y	Y	Y			
Move area					Y				
Zoom			Y	Y	Y				
Oops	Y		Y	Y		Y			
Brush	Y	Y	Y	Y	Y	Y		Y	
Mirror	Y	Y	Y	Y	Y				
Text	Y	Y		Y	Y		Y	Y	
Hard Copy	Y		Y	Y				Y	Y
Save/Load	Y	Y	Y	Y	Y	Y	Y	Y	Y
Control	Joy	Key	Pad	Tablet	Joy/Key	Joy/Key	Language	Mouse	Language

Key:
H = Hi-res
M = Medium-res
Y = Yes

Turbo 50 on cartridge

Eric Doyle reviews Robcom's Turbo 50 cartridge and finds out how versatile it is.



ONE AREA WHERE CARTRIDGES HAVE proved their worth is as utility/Basic extension units. Robocom's Turbo Series of cartridges falls very firmly into this category adding toolkit Basic commands; disk, cassette, printer control systems and a machine code monitor. The unit also has a very useful soft reset button which can get the unwary programmer out of some very sticky situations.

The cartridge which I have been using is the Turbo 50 which derives its name from the fast disk or cassette load and save commands. The disk turbo boasts an increase of five times normal loading speed and the cassette clocks in at 10 times normal speed. This was the point at which I discovered that, although my disk drive worked tolerably well at normal speed, the turbo speed was too much and misloads occurred. A tape head alignment tape is provided with the package so I had no problems there, it's a pity that a similar facility was not provided for disk drives. Fortunately I have access to an alternative 1541 which proved man enough for the job. At least this cartridge merely supplements the existing commands which can still be accessed by using standard syntax so my old drive was still usable at normal speed.

The best addition is the MERGE command which offers a simple way to assemble prepared subroutines into a program already in memory, but the COPY commands come a close second, simplifying transfer of programs to and from disk, turbo tape or normal speed tape. Although a small point, it would be nice if the producers of turbo tape systems would include a boot program which would allow turbo tapes to load on any system without the cartridge. This would limit inconvenience if the cartridge is damaged in any way.

Another niggle is the fact that FILE NOT FOUND is replaced with the message LOAD ERROR which caused me a little confusion.

The cartridge also adds toolkit commands such as auto numbering, selective renumbering and deletion of program lines. Added to this are three very useful commands: PLIST, TRACCE and FIND. The first lists the current program to the screen one page at a time and TRACE displays the current line in full at the top of the screen as the program slowly runs. FIND will locate a variable, command word or string wherever it lies in program memory and list the relevant lines to the screen.

Unfortunately, TRACE must either be used throughout the program or be used to run a small section which uses no variables. This is because using TRACE is like using RUN – all stored variables are cleared. It would have been better to devise a system where the trace automatically takes over from the normal run speed at a specified line.

HELP is also a debugging command which will automatically list a line in which an error has occurred and try to indicate the fault. If more serious problems occur and the computer crashes it is a simple matter to press the reset button and use OLD to restore the program in memory. This command can also be used if you accidentally NEW a program.

Other commands allow conversions between HEX and DEC numerical systems, cause all the keys to REPeat, turn off the activated function keys, switch out the cartridge, set the border and screen colours, SHOW all the commands available or RESET the computer.

Printer commands allow Centronics printers to be driven by the 64 and listing of programs is achieved by using the CENT command to select the correct mode and then using normal syntax to open the file and LIST. Two of these modes cause the special characters (for colour, cursor positioning etc.) to be printed out in a more readable form, similar to the listings in this magazine.

The final section held within this amazing little package is the machine code monitor which must be transferred into memory by typing MON followed by the Hex location. The location can lie anywhere between $0800 and $9FFF but if $C000 to $CFFF is preferred this can be done by dumping the monitor into any part of memory, switching off the cartridge using QUIT (because this occupies the area of memory we wish to use) entering the SYS command to activate the monitor and then using the Origin command to transfer it up to $C000.

The monitor itself has no surprises in store. Assembly, disassembly, trace, relocation, ASCII screen dumps and searches are all catered for, as well as disk commands.

The package of a toolkit/monitor with turbo commands and an azimuth alignment tape offers good value for money and I particularly like the fact that the turbo is optional. Now how about a disk alignment program on a turbo cartridge?

FRO



In a new series, Daryl Bowers shows you the techniques for writing your own arcade game.

RIGHT, STOP IDLY FLICKING through this magazine and get typing! I'm going to show you how to put together an arcade game piece by piece, a section in each issue of the mag. Each part will add to the original until the game is complete.

This is not a lesson in how to program in machine code – there are several good books available – and if it was, I would need the whole magazine for 12 months. Instead, it shows the application of Machine Code on the C64, and how to approach the creation of an entertaining masterpiece! The routines that follow can be taken from this game and used in any of your own.

To give you an idea of the complexity of the game, it took about a week to write and debug – so see what can be achieved with relatively little work.

The Game

You play the part of a poor, helpless giant frog! There you are hopping down the road, minding your own business, when suddenly you find yourself being chased by a mad Frenchman on a bicycle, hoping to catch some dinner! To make matters worse, you are feeling pretty tired and there are pitifully few juicy flies about – and, while you're catching one, you have got to watch out for low flying birds.

Oh! and don't forget to avoid the puddles! They make jumping very hard work.

The First Part

In this first 'building block', I have provided the sprite data for the frog and an input program that will be used in future parts.

Type in the basic program, and enter the start address: 12800. There are 512 bytes of sprite data, and the checksums are at the end of each line. If you make a mistake, type 999 and retype the last line. Save the data under the name 'FROGDAT'. (If using tape change line 220 to read: POKE 780,1: POKE 781,1 etc).

```
10 REM HEX LOADER
20 REM
30 INPUT "START ADDRESS";A
40 INPUT "NO. OF BYTES ";N
50 FOR F=A TO A+N-1 STEP 8
60 CH=0
70 PRINT F;:INPUT ":";H$
80 IF H$="999" THEN F=F-8:GOTO 70
90 IF LEN(H$)<>16 THEN 70
100 FOR I=0 TO 7
110 X=ASC(MID$(H$,I*2+1,1))
120 Y=ASC(MID$(H$,I*2+2,1))
130 X=X-48:IF X>9 THEN X=X-7
140 Y=Y-48:IF Y>9 THEN Y=Y-7
150 POKE F+I,X*16+Y:CH=CH+X*16+Y
160 NEXTI
170 PRINT"         ";CH
180 NEXT F
200 INPUT "FILE NAME ";F$
210 FOR I=1 TO LEN(F$):POKE 39999+I,ASC(MID$(F$,I,1)):NEXT
220 POKE 780,8:POKE 781,8:POKE 782,1
230 SYS 65466
240 POKE 780,LEN(F$):POKE 781,64
250 POKE 782,156:SYS 65469
260 POKE 252,A-(256*INT(A/256)):POKE253,INT(A/256):POKE 780,252
270 POKE 781,F-(256*INT(F/256)):POKE 782,INT(F/256):SYS 65496
```

The Code

OK, now you've got the data in for the jolly hopping frog, it's time to look at the program. You will, of course, need an assembler, and if you haven't got one already you can type in Mach 1 which started in the November issue.

In this section we have some mind-boggling routines, starting with the routine to print the frog: 'PRFROG'. The variable 'stage' holds the current position in the X and Y co-ordinate table: 'XTAB'. This table governs the relative positions of the two sprites which go to make up the frog. There are two types of jump, high and low, and this is indicated by a one or zero in the variable 'JUMPTYPE'. One last table is used, 'SPTAB', which indicates which sprite definitions are used and at what point in the jump.

The X register is used to index into the tables and retrieve the current values. (To see what each of these values does, it is helpful to look at pages 320 to 334 of the Programmer's Reference Guide).

OGGY



```
 10                .ORG     $2000
 20                ;
 30                ;
 40                ;
 50 VARS
 60 XTAB1          .BYTE    184,184,184,184,184,184,184,184
 70                .BYTE    184,184,184,184,184,184,184,184
 80 XTAB2          .BYTE    136,136,136,136,136,136,136,136
 90                .BYTE    136,136,136,136,140,140,140,140
100 YTAB1          .BYTE    156,156,156,156,134,132,130,128
110                .BYTE    124,122,124,126,156,156,156,156
120 YTAB2          .BYTE    156,156,156,156,156,154,152,150
130                .BYTE    130,128,130,132,150,150,150,150
140 STAGE          .BYTE    0
150 XTAB1B         .BYTE    184,184,184,184,184,184,184,184
160                .BYTE    184,184,184,184,184,184,184,184
170                .BYTE    184,184,184,184,184,184,184,184
180 XTAB2B         .BYTE    136,136,136,136,136,136,136,136
190                .BYTE    136,136,136,136,136,136,136,136
200                .BYTE    136,136,136,136,140,140,140,140
210 YTAB1B         .BYTE    156,156,156,156,134,132,130,128
220                .BYTE    126,124,122,120,118,116,114,112
230                .BYTE    112,114,118,124,156,156,156,156
240 YTAB2B         .BYTE    156,156,156,156,156,154,152,150
250                .BYTE    148,146,144,142,120,118,116,114
260                .BYTE    114,116,120,124,150,150,150,150
270 SPTAB          .BYTE    200,200,200,200,202,202,202,202,204,204,204,204
280                .BYTE    206,206,206,206
290 SPTAB2         .BYTE    200,200,200,200,202,202,202,202,202,202,202,202
300                .BYTE    204,204,204,204,204,204,204,204,206,206,206,206
310 TEMP1          .BYTE    0
320 DELAY          .BYTE    1
330 RESTORE1       .BYTE    255
340 RESTORE2       .BYTE    200
350 COLTAB         .BYTE    1,1,1,1,1,4,4,4,4,4,0,0,0,0,0,0,0,1,1,1,0,0,0,0,0
360 RDTAB          .BYTE    160,160,160,160,160,160,160,160,160,160,32,32,32
370                .BYTE    32,32,32,32,32,32,32,160,160,160.160,160,160,160
380                .BYTE    160,160,160,32,32,32,32,32,32,32,32,32,32
390 CLOUD1         .BYTE    32,32,171,171,171,171,171,171,171,32,32
400 CLOUD2         .BYTE    32,171,171,171,171,171,171,171,171,171,32
410 CLOUD3         .BYTE    171,171,171,171,171,171,171,171,171,171,171
```

The second awe-inspiringly complicated routine (try saying that 10 times quickly!) is 'MVFROG', which if you haven't guessed, moves the frog! When jumping, a different speed is used between movements in order to make the long jump longer, and the two values of delay are stored in 'RESTORE1' and 'RESTORE2'. At this stage, however, this difference is irrelevant because everything is happening too quickly, and will continue to do so until we have introduced some more routines.

This routine follows the steps shown in FLOWCHART 1. The variable 'NXTJUMP' contains the type of jump to be introduced next, and this will be altered when the joystick routines are added.

Finally, the last routine 'INIT' which sets up various parameters for the game. This routine is called whenever the game starts, and is self explanatory.

The variables at the start of the listing are all the variables required for the whole game, therefore in future we shall have room for more routines. In the next part we shall introduce a multi-purpose raster interrupt handling routine, and more routines with long names.

Now that you have got the code in, it's time to try it out. Assemble it and find out the address of 'START'. This is the start of the program, and should be $2329 (9001) if you've typed in the variables and tables correctly. If not check them over again. Reset the machine and load in your object code (assembled source code). Now load in your frog data – FROGDAT – and SYS 9001. Bingo! (Don't tell me it doesn't work – I wrote it and it does...so check your source code, dummy.)

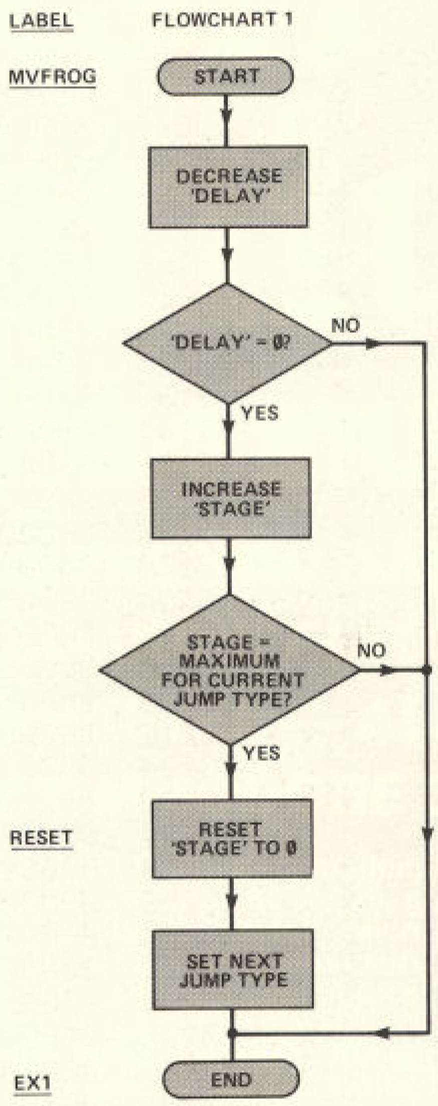
For further information on Machine code and the C64 I suggest *Programming the 6502* by Rodney Zaks (I know it costs a tenner, but I assure you it's worth it if you're serious), and a *Programmer's Reference Guide* is pretty essential – (I never knew there was so much in it!).

Now get typing.

```
420                       ;
430 BLDNG1
440                       .BYTE   32,32,32,32,32,32,32,$A0,32,32
450                       .BYTE   $A0,$A0,$A0,$A0,$A0,$A0,$A0,$A0,$A0,32
460                       .BYTE   $A0,91,$A0,91,$A0,91,$A0,91,$A0,32
470                       .BYTE   $A0,$A0,32,$A0,$A0,$A0,$A0,$A0,$A0,32
480 BLDNG2
490                       .BYTE   32,$A0,32,$A0,32,32,32,32,32,32
500                       .BYTE   32,$A0,32,$A0,32,32,32,32,32,32
510                       .BYTE   $A0,$A0,$A0,$A0,$A0,$A0,$A0,$A0,$A0,32
520                       .BYTE   $A0,$A0,$A0,$A0,$A0,$A0,$A0,32,$A0,32
530                       ;
540                       ;
550                       ;
560                       ;
570                       ;
710 BLDNGTAB
720                       .BYTE   0,0,1,0,0,2,0,0,0,2,1,0,0,2,1,2,0,0,2,1,0,255
730                       ;
740                       ;
750                       ;
760                       ;
770                       ;
780 CLCOUNT               .BYTE   1
790 CLSPEED               .BYTE   2
800 JUMPTYPE              .BYTE   0
810 NXTJUMP               .BYTE   0
820 JOYSTATUS             .BYTE   0
830 BLDNGSTAGE            .BYTE   0
840 BLDNGTYPE             .BYTE   0
850 BLDNGPOS              .BYTE   0
860 MVLOOP                .BYTE   1
870 STAT1                 .BYTE   '       METERS : 00000       LIVES : 3      '
880 STAT2                 .BYTE   '       SCORE  : 00000       FOOD  : 99     '
890 CRATER                .BYTE   10
900 RDTYPE                .BYTE   0
910 RDTYPE2               .BYTE   5
920 CRATEDEL              .BYTE   10
930 CRATEDEL2             .BYTE   10
940 RANDTAB               .BYTE   0,0,1,0,0,0,0,1,0,0,1,0,0,0,0,1,0,0,0,0,0
950                       .BYTE   0,0,0,0,1,0,0,0,1,0,0,1,0,0,0,0,0,1,0,0,0,0,0,1
960                       .BYTE   0,1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,1
970                       .BYTE   0,0,0,1,0,0,0,0,0,1,0,0,1,0,0,1,0,0,0,0,1,255
980                       .BYTE   0,1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,1
990                       .BYTE   0,0,0,1,0,0,0,0,0,1,0,0,1,0,0,1,0,0,0,0,1,255
1000 RANDTAB3             .BYTE   0,1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,1
1010                      .BYTE   0,0,0,1,0,0,0,0,0,1,0,0,1,0,0,1,0,0,0,0,1,255
1020                      .BYTE   0,1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,1
1030                      .BYTE   0,0,0,1,0,0,0,0,0,1,0,0,1,0,0,1,0,0,0,0,1,255
1040 RANDPOS              .BYTE   0
1050 FRENCH               .BYTE   80,60,108,74
1060 FRENCH2              .BYTE   20,0,48,14
1070 FRSPRT               .BYTE   211
1080 FRDEL                .BYTE   10
1090 BIKEMV               .BYTE   $FF,80,80,0,70,70,1,50,80,$FF,55,90,1,55,80,$FF,80
1100                      .BYTE   80
1110                      .BYTE   1,65,90,$FF,60,90,0,70,50,1,50,80,$FE
1120 BIKEPOS              .BYTE   0
```



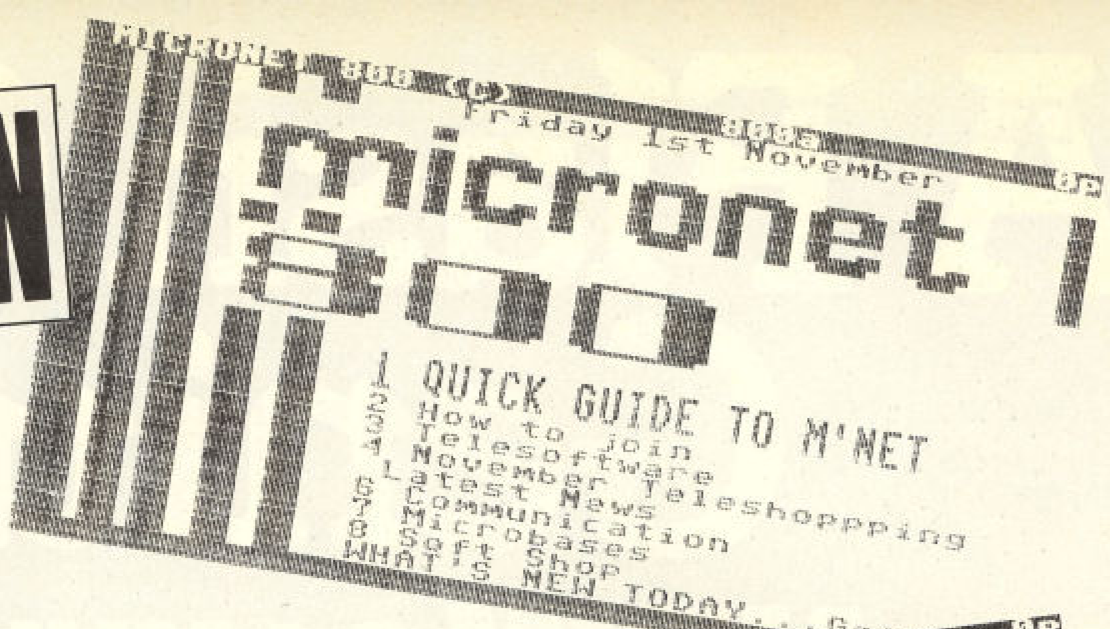
```
1130 BIKEDEL      .BYTE   10
1140 BIKEDIS      .BYTE   10
1150 FLYDEL       .BYTE   1
1160 FLYXHI       .BYTE   1
1170 FLYXLO       .BYTE   255
1180 FLYMOVE      .BYTE   1
1190 FLYSPD       .BYTE   38
1200 WINGFLY      .BYTE   1
1210 FLYWDEL      .BYTE   1
1220 WINGBRD      .BYTE   1
1230 BRDWDEL      .BYTE   1
1240 BRDDEL       .BYTE   1
1250 BRDXHI       .BYTE   1
1260 BRDXLO       .BYTE   255
1270 BRDMOVE      .BYTE   1
1280 BRDSPD       .BYTE   15
1290 FLYPOS       .BYTE   0
1300 BRDPOS       .BYTE   0
1310 LIVES        .BYTE   '3'
1320 FOOD         .BYTE   '99'
1330 METERS       .BYTE   '00000'
1340 SCORE        .BYTE   '00000'
1350 METDEL       .BYTE   10
1360 METSPD       .BYTE   3
1370 METDEL2      .BYTE   1
1380 DED          .BYTE   0
1390 ONLY         .BYTE   0
1400 RDDEDEL      .BYTE   1
1410 TABIK        .BYTE   10,10,10,10
1420 NXTHUN       .BYTE   1
1430 TABMOV
1470 START
1480              JSR INIT
1490              ;
1500 MLOOP
1510              ;MAIN LOOP
1520              ;
1530              ;
1540              JSR PRFROG
1550              JSR MVFROG
1590              JMP MLOOP
1660 PRFROG
1690              LDA JUMPTYPE
1700              BNE BIG
1710              LDX STAGE
1720              LDA XTAB1,X
1730              STA $D000
1740              LDA XTAB2,X
1750              STA $D002
1760              LDA YTAB1,X
1770              STA $D001
1780              LDA YTAB2,X
1790              STA $D003
1800 DEFSET
1810              ;
1820              LDA SPTAB,X
1830              STA $07F8
```




```
1840            TAX
1850            INX
1860            STX $07F9
1870            ;
1880            RTS
1890            ;
1900 BIG        LDX STAGE
1910            LDA XTAB1B,X
1920            STA $D000
1930            LDA XTAB2B,X
1940            STA $D002
1950            LDA YTAB1B,X
1960            STA $D001
1970            LDA YTAB2B,X
1980            STA $D003
1990            LDA SPTAB2,X
2000            STA $07F8
2010            TAX
2020            INX
2030            STX $07F9
2040            ;
2050            RTS
2060            ;
2140 MVFROG     DEC DELAY
2150            BNE EX1
2160            INC STAGE
2170            LDX STAGE
2180            LDA JUMPTYPE
2190            BNE LARGE2
2200            LDA RESTORE1
2210            STA DELAY
2220            CPX #16
2230            BNE EX1
2240            JMP RESET
2250 LARGE2
2260            LDA RESTORE2
2270            STA DELAY
2280            CPX #24
2290            BNE EX1
2300 RESET      LDX #0
2310            STX STAGE
2320            LDA NXTJUMP
2330            STA JUMPTYPE
2340            STX NXTJUMP
2350 EX1
2360            RTS
2500 INIT
2510            ;
2520            ;INITIALISE STATUS
2530            ;SPRITE COLOURS
2540            ;
2550            LDA #5
2560            STA $D027
2570            STA $D028
2580            LDA #0
2590            STA $D026
2600            LDA #1
2610            STA $D025
2620            LDA #6
2630            STA $D029
2640            LDA #0
2650            STA $D02A
2660            STA $D02B
2670            STA $D02D
2680            LDA #2
2690            STA $D02C
2700            ;
2710            ;ENABLE SPRITES
2720            ;
2730            LDA #$FF
2740            STA $D015
2780            ;SPRITE MULTICOLOURS
2790            ;
2800            LDA #167
2810            STA $D01C
2820            ;
2830            ;SPRITE EXPAND
2840            ;
2850            LDA #63
2860            STA $D01D
2870            STA $D017
2880            ;
2890            LDX #$00
2900 LOOP2
2910            LDA #$20
2920            STA $0400,X
2930            STA $0500,X
2940            STA $0600,X
2950            STA $06F7,X
2960            DEX
2970            BNE LOOP2
2980            ;
2990            ;SET UP SCREEN COLOURS
3000            ;
3010            LDA #$00
3020            STA $FB
3030            LDA #$D8
3040            STA $FC
3050            LDX #$00
3060 LOOP3
3070            LDY #$27
3080            LDA COLTAB,X
3090 LOOP4
3100            STA ($FB),Y
3110            DEY
3120            BPL LOOP4
3130            LDA $FB
3140            CLC
3150            ADC #$28
3160            STA $FB
3170            LDA $FC
3180            ADC #$00
3190            STA $FC
3200            INX
3210            CPX #25
3220            BNE LOOP3
3230            ;
3240            ;SET UP ROAD
3250            ;
3260            LDY #$27
3270 LOOP5
3280            LDA RDTAB,Y
3290            STA $06D0,Y
3300            DEY
3310            BPL LOOP5
3320            ;
3330            ;DRAW CLOUDS
3340            ;
3350            LDX #10
3360 LOOP8
3370            LDA CLOUD1,X
3380            STA 1064,X
3390            LDA CLOUD2,X
3400            STA 1104,X
3410            LDA CLOUD3,X
3420            STA 1144,X
3430            DEX
3440            BPL LOOP8
3450            ;
3460            ;
3470            RTS
3480 FINISH
3490            .END
```

```
12800 :0000000000000000 CH : 0
12808 :0000000000000000 CH : 0
12816 :00000000800002A0 CH : 290
12824 :02AA68AAAAEAAAAA CH : 1190
12832 :BFAAAAA8FAAAA8AE CH : 1461
12840 :AAA0AEAAA0EBAA80 CH : 1367
12848 :ABAA00AAAA00C00A CH : 883
12856 :00A00A00A80A8002 CH : 478
12864 :0000000000000000 CH : 0
12872 :0000000000000000 CH : 0
12880 :0000000000000000 CH : 0
12888 :0000020000A0000 CH : 12
12896 :2A00002F00002A00 CH : 131
12904 :002A00002A00000F CH : 99
12912 :00002A0000AA0000 CH : 212
12920 :AF0000AA0000AA02 CH : 517
12928 :0000800002A00AAA CH : 470
12936 :682AAAEA2AAABFAA CH : 1123
12944 :AAA8AAAAA0AAAA80 CH : 1306
12952 :AAAA00AAA800AAA8 CH : 1016
12960 :00AAA800A80800A0 CH : 674
12968 :0800A00800A00A00 CH : 346
12976 :A00A00A000008000 CH : 458
12984 :0080000080000002 CH : 258
12992 :0000020000020000 CH : 4
13000 :0200000200000200 CH : 6
13008 :00020000A00000A CH : 22
13016 :00000A00002A0000 CH : 52
13024 :AA0002AA000AA800 CH : 520
13032 :2A8000A800008000 CH : 466
13040 :0280000200000200 CH : 134
13048 :0002000002000002 CH : 6
13056 :0000800A82A02AAA CH : 640
13064 :682AAAEAAAAABFAA CH : 1251
13072 :AAA8AAAAA0AAAA80 CH : 1306
13080 :AAAA80AAAA00A0AA CH : 1138
13088 :0000280000280000 CH : 80
13096 :2800002000002000 CH : 104
13104 :0020000000000000 CH : 32
13112 :00000000000000F7 CH : 247
13120 :0000000000000000 CH : 0
13128 :0000000200000200 CH : 4
13136 :000A00002A0000AA CH : 222
13144 :0000AA0002AA0002 CH : 344
13152 :A8000AA0002A8000 CH : 508
13160 :2A0000A80002A000 CH : 372
13168 :0A80002A00002800 CH : 220
13176 :00A00000800000F7 CH : 535
13184 :AA0000AA0000AA80 CH : 638
13192 :00AA8000AA8000AA CH : 766
13200 :A000EAA080AAAAA0 CH : 1182
13208 :BAAA68BAAAEAAAAA CH : 1390
13216 :BF0AAAA802AAA002 CH : 873
13224 :AA8000AA00002800 CH : 508
13232 :002800000800000A CH : 58
13240 :00000200000280F7 CH : 379
13248 :000800002AA0002A CH : 252
13256 :AA002BAA00BAAA02 CH : 741
13264 :AAEA0A2EAA082ABA CH : 866
13272 :080BAA080AAE0802 CH : 391
13280 :EA0802AB0800AB08 CH : 602
13288 :00AA080000080000 CH : 186
13296 :0000000000000000 CH : 0
13304 :00000000000000F7 CH : 247
```

COMPETITION



Have you always fancied getting on-line? Well Micronet 800 will help you with this month's competition.



WOULD YOU LIKE TO BECOME PART OF the electronic revolution? Do you fancy being able to send messages to your friends via a telephone? Well this month Micronet 800 is offering £1000 of prizes to help 54 readers of Your Commodore to get on line.

A large number of different prizes are being offered.

1st prize is a Commodore modem and 1 year's free subscription to Micronet and Prestel

2nd prize is 1 year's free subscription to Micronet and Prestel

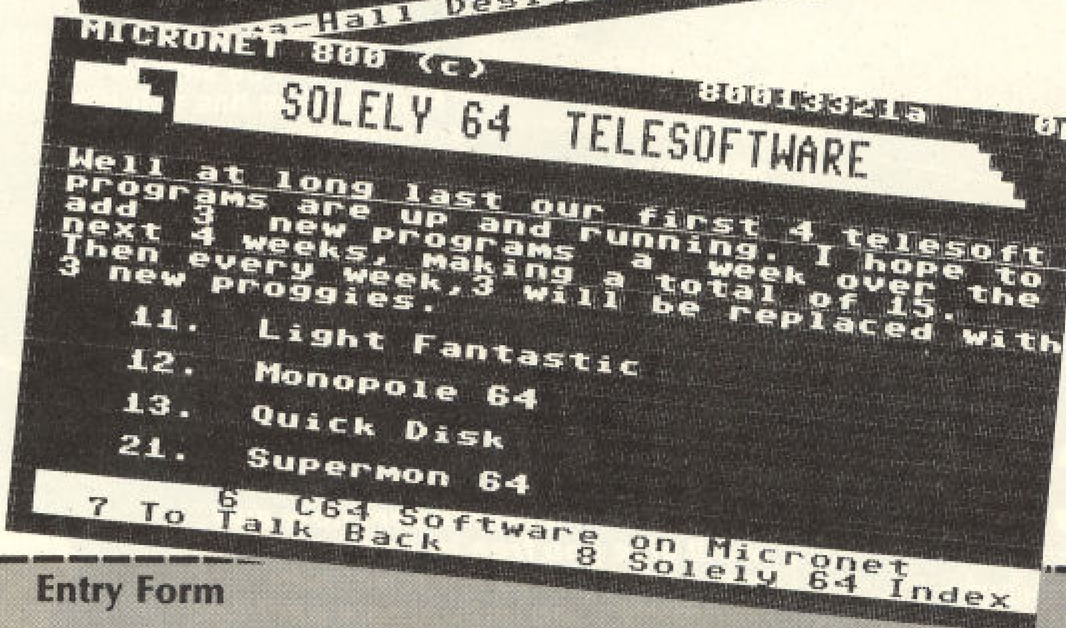
3rd prize is 6 month's free subscription

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Plus there are prizes for 30 runners up of £10 worth of some of the latest Commodore software.

A further 20 readers will receive a selection of software that is available on Micronet.

So as you can see there are plenty of prizes up for grabs and everyone stands a chance of winning.



How to enter

On the competition entry form you will find five different things that are available on Micronet. All you have to do is put them into the order that you think is most important. For example if you thought that telesoftware is the most important then you would put a number 1 by the side of it.

When you have done this you then have to complete the sentence given in no more than 15 words.

Then put your entry form into an envelope and write the order of importance on the back.

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Entries will not be accepted from employees of Argus Specialist Publications and Micronet 800. This restriction also applies to employees' families and agents of the company.

The How to Enter section forms part of the rules. The editor's decision is final and no correspondence will be entered into.

Entry Form

Name ....

Address ....

....

....

.... Post code.......

Number these services in order of importance –

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Telesoftware

International Telex

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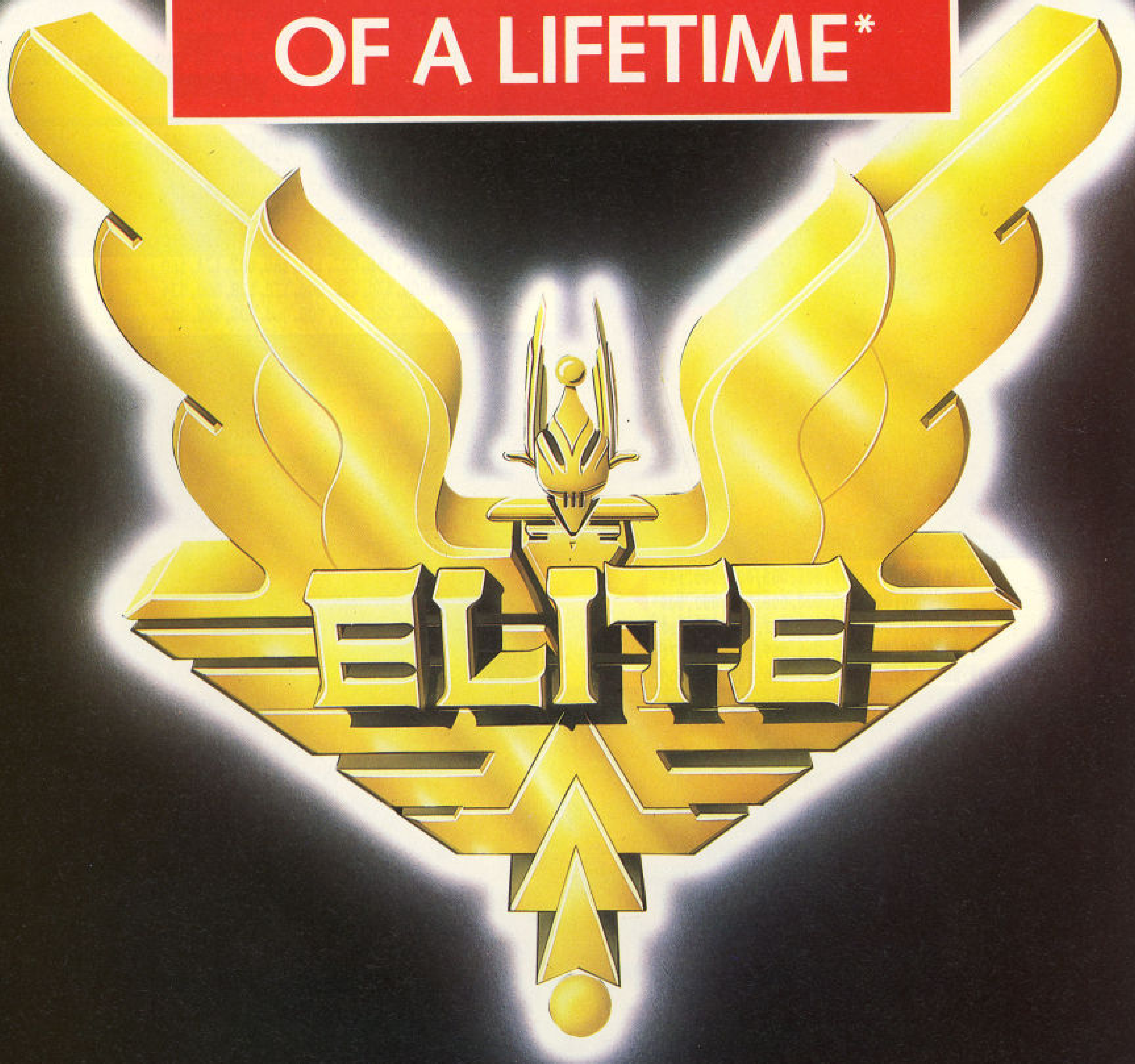
Complete the following sentence in less than 15 words:

Micronet 800 is the ultimate peripheral because ....

....

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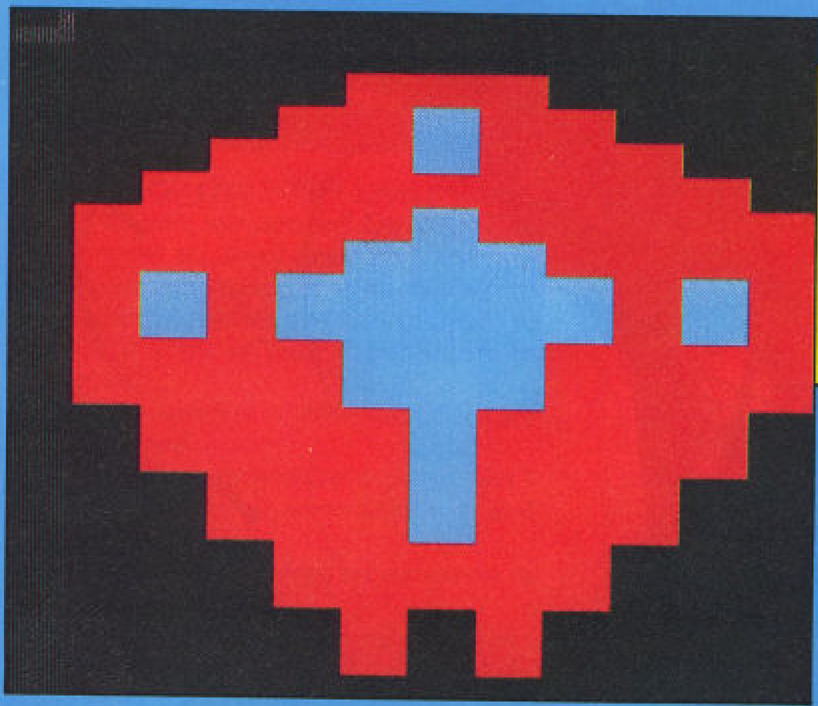
SPRITE IDEAS

When you are designing a game one of the longest jobs is designing the sprites. If you are good at art then fine, if not your next monster will probably end up looking like a square box with legs.

Now, Your Commodore comes to the rescue once again with Sprite Ideas. If you have designed any sprites for games and you don't mind other people seeing your masterworks then why not send them into us. Each month we will be offering £10 for the best entries.

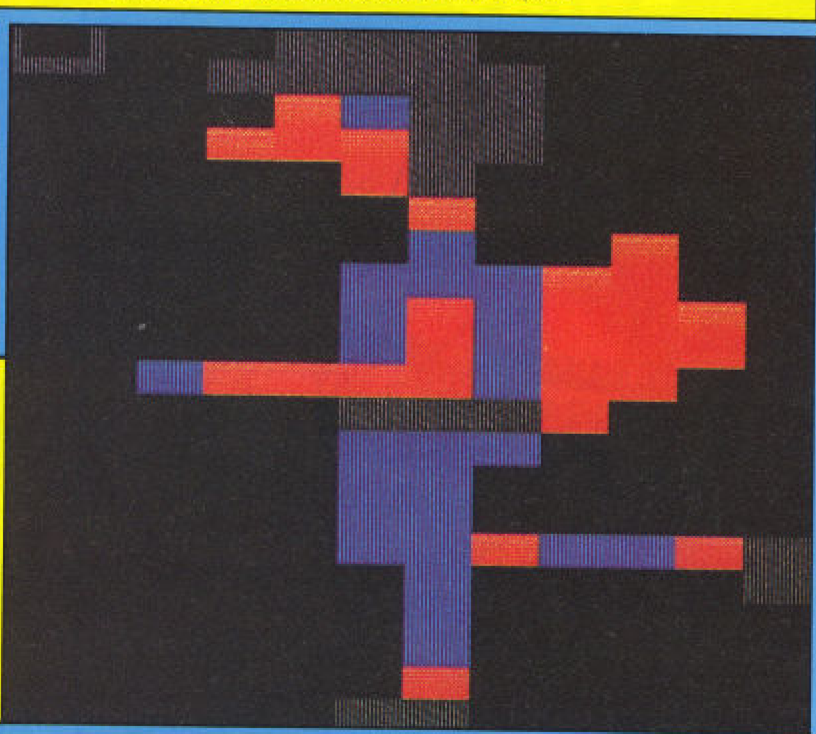
Your sprites can be anything at all (within reason), if you've designed a series of animated characters then send in the lot. We'd love to have a look at them.

So, next time you are after an Ogre to put in your new game, have a look in this section of the magazine and you may find just what you are looking for.



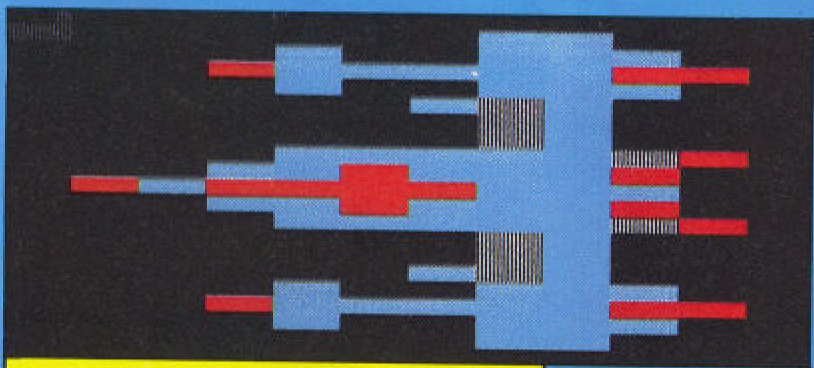
```
64 DATA000,000,000,000,000,000,000,042
65 DATA000,000,174,128,002,174,160,010
66 DATA170,168,042,174,170,042;191,170
67 DATA046,255,238,046,255,238,042,191
68 DATA170,042,191,170,010,174,168,010
69 DATA174,168,002,174,160,002,174,160
70 DATA000,170,128,000,170,128,000,034
71 DATA000,000,034,000,000,000,000,001
```

Cruiser J Garton : Rotherham



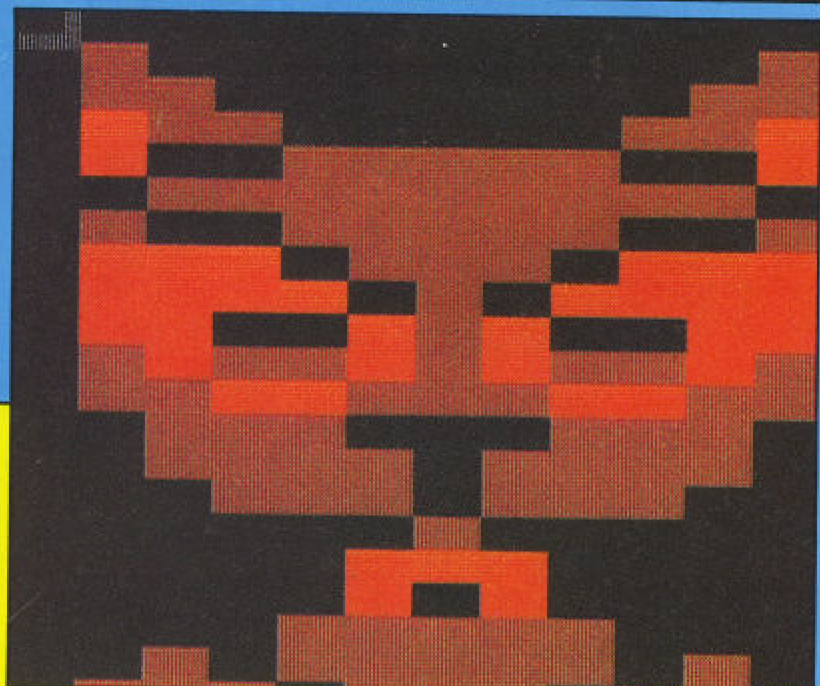
```
37 DATA000,084,000,001,085,000,000,149
38 DATA000,002,165,000,000,036,000,000
39 DATA008,000,000,012,032,000,063,160
40 DATA000,059,168,000,059,168,014,171
41 DATA160,000,021,128,000,063,000,000
42 DATA060,000,000,060,000,000,062,249
43 DATA000,012,001,000,012,000,000,012
44 DATA000,000,008,000,000,020,000,000
```

Jetman Tony Crowther : Sheffield



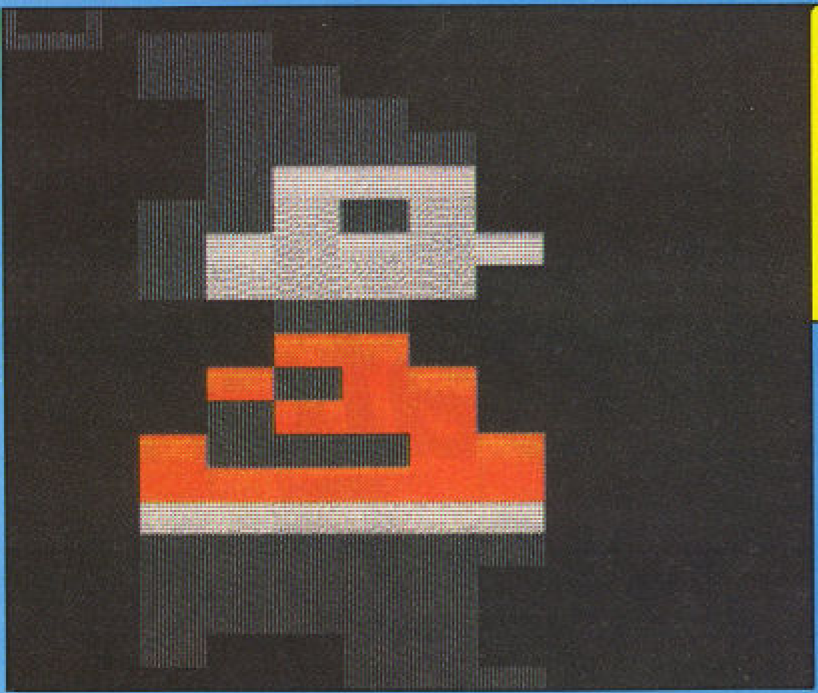
```
55 DATA000,000,000,000,003,192,000,195
56 DATA240,002,255,232,000,195,240,000
57 DATA013,192,000,001,192,000,001,192
58 DATA000,255,216,003,239,224,046,171
59 DATA240,003,239,224,000,255,216,000
60 DATA001,192,000,001,192,000,013,192
61 DATA000,195,240,002,255,232,000,195
62 DATA240,000,003,192,000,000,000,000
```

Gunship J Garton : Rotherham



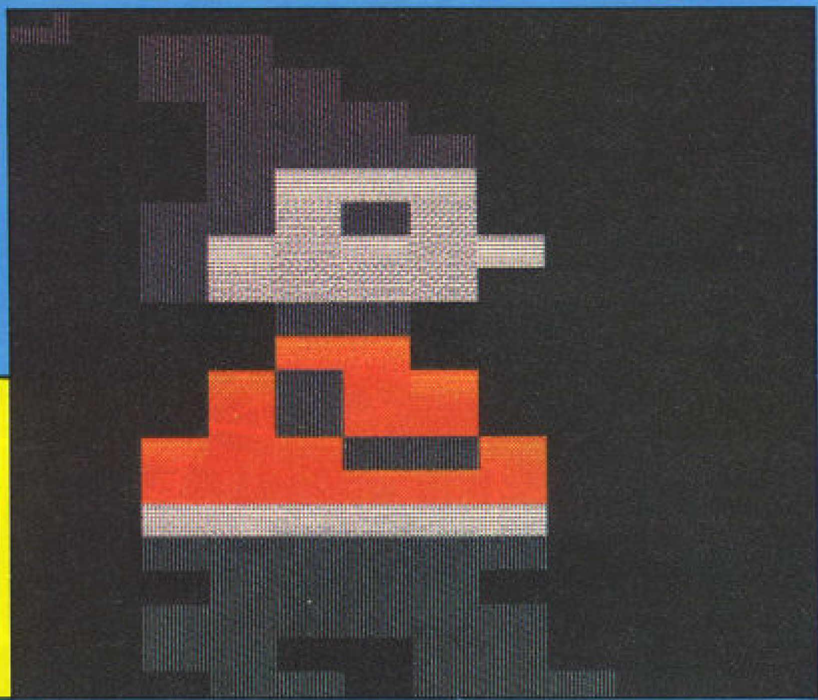
Dog
Tony Crowther
: Sheffield

```
46 DATA000,000,000,032,000,002,040,000
47 DATA010,058,000,043,053,170,151,026
48 DATA170,169,037,170,150,063,106,127
49 DATA063,217,255,061,123,095,046,187
50 DATA174,043,234,250,010,149,168,010
51 DATA166,168,002,166,160,000,025,000
52 DATA000,063,000,000,119,064,000,170
53 DATA128,009,170,152,042,106,106,042
```



Dwarf 1 2 3 4
Tony Crowther : Sheffield

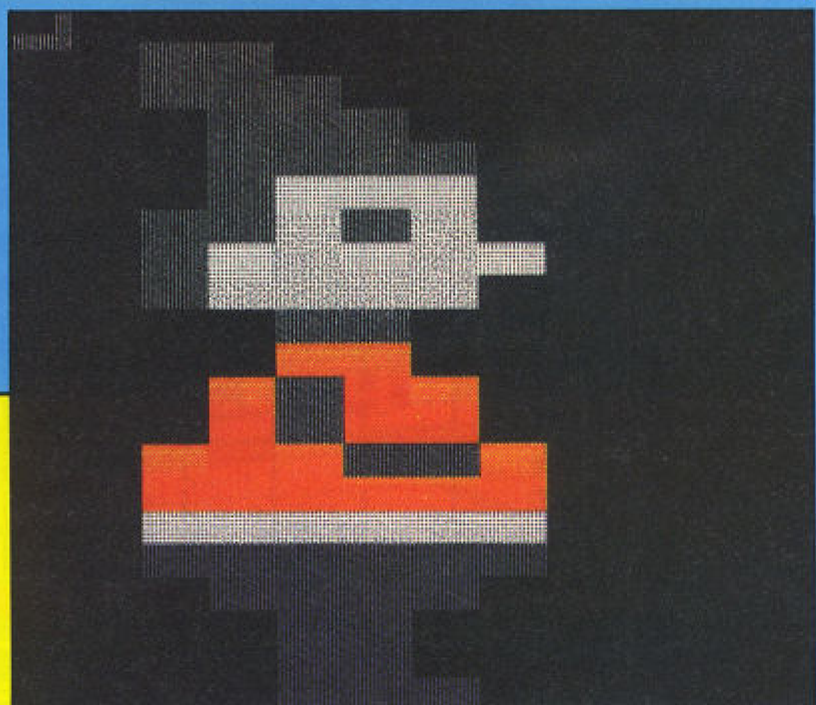
```
1 DATA000,000,000,005,000,000,005,064
2 DATA000,001,080,000,001,084,000,001
3 DATA252,000,005,220,000,007,255,000
4 DATA007,252,000,000,080,000,000,160
5 DATA000,002,104,000,001,168,000,009
6 DATA090,000,010,170,000,015,255,000
7 DATA005,085,000,005,084,000,005,084
8 DATA000,004,020,000,000,021,000,000
```



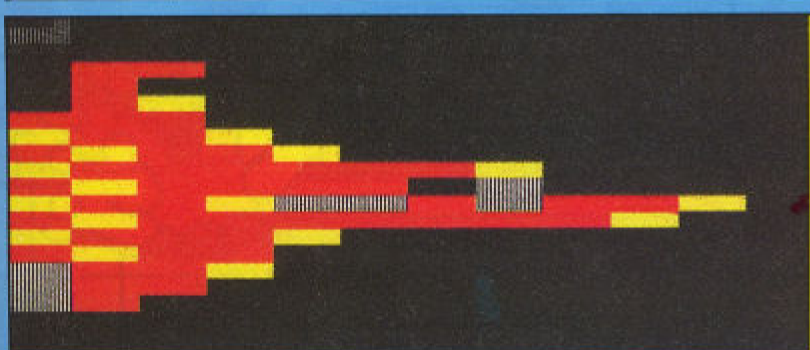
```
10 DATA000,000,000,005,000,000,005,064
11 DATA000,001,080,000,001,084,000,001
12 DATA252,000,005,220,000,007,255,000
13 DATA007,252,000,000,080,000,000,160
14 DATA000,002,104,000,002,104,000,010
15 DATA150,000,010,170,000,015,255,000
16 DATA005,085,000,001,084,000,005,085
17 DATA000,005,005,000,001,069,064,000
```



```
19 DATA000,000,000,005,000,000,005,064
20 DATA000,001,080,000,001,084,000,001
21 DATA252,000,005,220,000,007,255,000
22 DATA007,252,000,000,080,000,000,160
23 DATA000,002,104,000,002,152,000,010
24 DATA165,000,010,170,000,015,255,000
25 DATA005,085,000,001,084,000,000,085
26 DATA000,001,069,064,001,080,000,000
```



```
28 DATA000,000,000,005,000,000,005,064
29 DATA000,001,080,000,001,084,000,001
30 DATA252,000,005,220,000,007,255,000
31 DATA007,252,000,000,080,000,000,160
32 DATA000,002,104,000,002,104,000,010
33 DATA150,000,010,170,000,015,255,000
34 DATA005,085,000,001,084,000,000,080
35 DATA000,000,080,000,000,084,000,000
```



```
73 DATA000,000,000,000,000,000,000,000
74 DATA000,060,000,000,048,000,000,056
75 DATA000,000,252,000,000,190,000,000
76 DATA239,128,000,191,254,000,239,241
77 DATA000,190,093,248,239,255,224,191
78 DATA128,000,239,000,000,126,000,000
79 DATA124,000,000,112,000,000,000,000
80 DATA000,000,000,000,000,000,000,000
```

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COMMUNICATION CORNER

All the latest news, views and mere rumours on line from David Janda.

WELCOME TO THE FIRST NEW-LOOK Communications Corner. Each month this column will be devoted to news about the comms scene as it effects us Commodore owners.

A large amount of space will be devoted to developments on the two major public DBs; Compunet and Micronet 800. Other systems including bulletin boards, viewdata systems and such like will also be covered.

As well as dishing out info on DBs I'll also inform you of the latest comms software and modem news. So, if you have any news, views, hints or tips then pass them on to me. I would like to make this column as interactive as possible so please feel free to drop me a line here at Your Commodore, or on one of the systems I use.

Bits

Considering buying a C128? If so, then you will have problems using your existing Compunet modem together with the Datassette recorder. Apparently the C64 modem, when used on the C128, slightly obstructs the cassette port. I have been told that Commodore is producing an identical modem with a different casing, which, when plugged in the back will allow you to use the cassette port.

PACE produces the popular Nightingale modem for BBC users and is now developing a comms package for the C64. Details are scarce at the moment, but the package will no doubt be supplied wlth an interface allowing said modem to be connected to the back of the C64.

The price of Gallery pages (323) on Micronet is about to go up. The Nets PR person told me that they have about 500 odd people waiting to get Gallery pages, and that the new charge per frame would "attract the more serious user". Hmm, I'd call it flushing out the wallies myself.

Micronet News

A number of new services have been, or soon will be, introduced on the Net.

The big news is that the Soley Sixty Four area has moved lock stock and barrel from Clubspot 810 to Micronet. The Net admits (it says here in the press release) that; "Commodore micro users have had a fairly raw deal in the past." The idea of having SSF on Micronet is to complement the existing services the Net provides for the Commodore owner.

SSF is run by Andy Waller (919994528), and I must say it does look good! Andy wants SSF to be as interactive as possible with lots of reader response and contribution. So next time you're on the Net GOTO page 800133.

Micronet's newish Public Relations man, Peter Probert has spilled the beans on what the Net is going to do in the near future.

First, a new multi-channel Chatline service should be in operation by the time you read this. The new Chatline service will offer 10 channels, some of which will be available to the general public. Unlike the present chatline service which is slow, the new multi-channel job will offer instant updates. As I understand, each channel will be dedicated to a specific topic e.g. computing, current affairs and so on. The word is that one of the channels will be "adult only". How on earth the Net intends to keep it "adult only" will provide one and all with a good laugh!

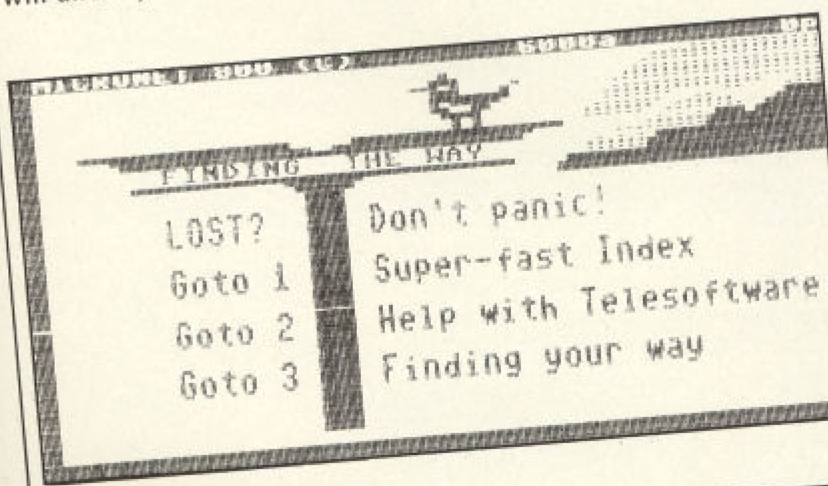
Buttons is a new entertainment area that will offer bored travel agent assistants and such like, quizzes, competitions and so on. If you have an original idea for a quiz or such like, then contact the Net which might even give you some money for the idea.

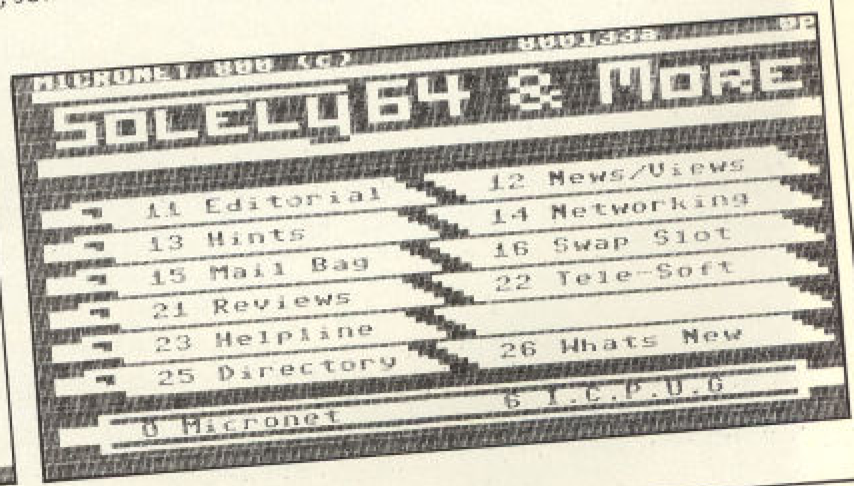
Bizznet is the Net's first non-micro exclusive venture. The 500 page area will provide business information for the small business user. Topics covered include legal advice, accounting, financial advice (and the list goes on).

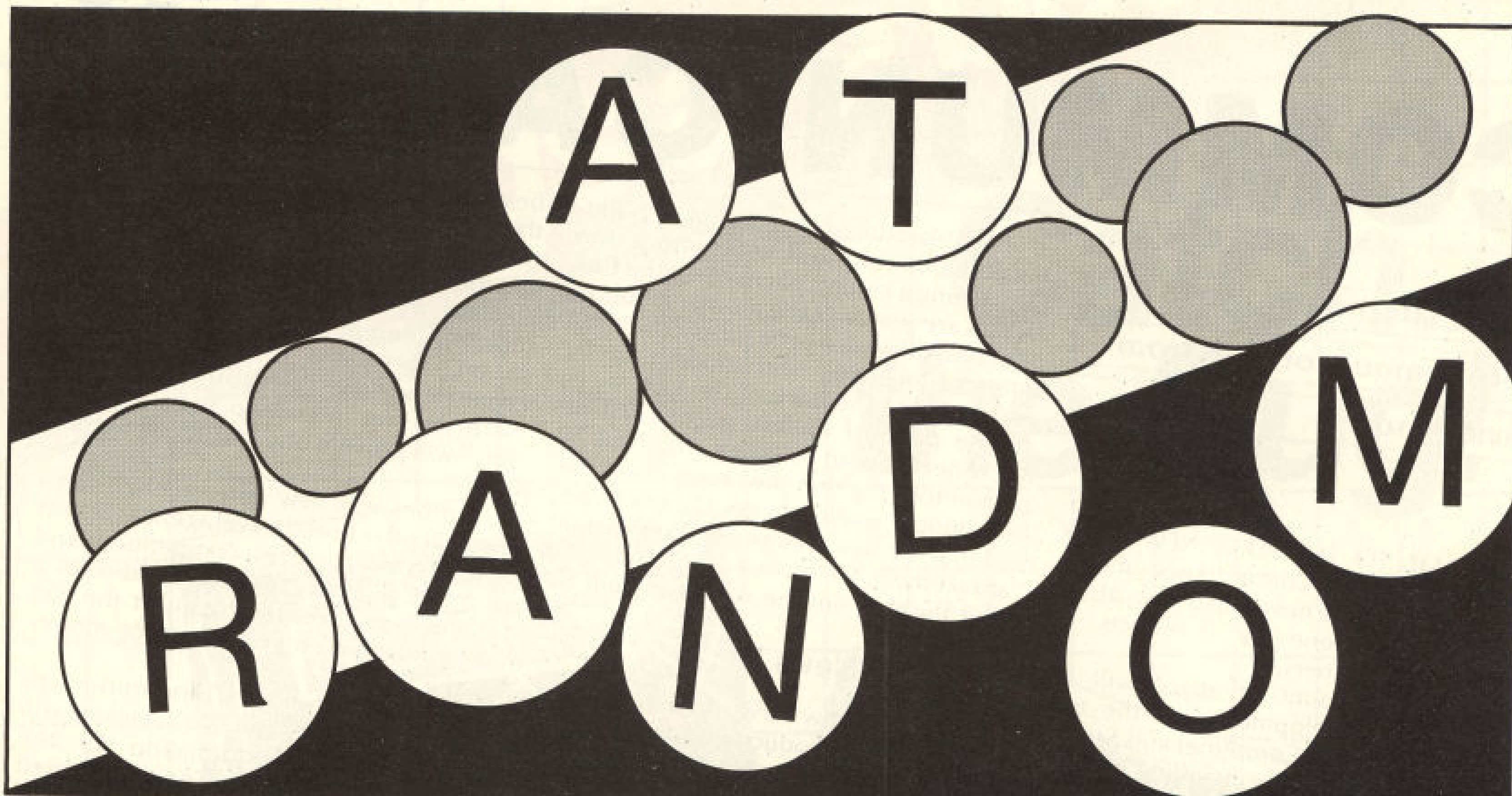
Oops! I've already run short of space, but I must tell you that the editor (bow) and myself were given a brief look at the new CB simulator that is being developed. Unlike most electronic CB simulators, this one splits the screen into two parts. The top part will display messages that have been sent by other users and yourself, whilst the bottom bit is used by you to hack in your message.

The rumour dept. has just informed me that Compunet is experimenting with a home banking service. Apparently one of the big banks is involved, and I will bring you more details next time.

Don't forget to drop me a line on: Prestel: 919992677, Compunet: YOUR CBM.







Allen Webb demonstrates random access on the 1541.

ONE OF THE PRIME BENEFITS of having a disk drive is the ability to access information both sequentially and by random access. Most of you will have used simple files such as sequential and relative files.

Sequential files are messy to use since, if you want only a portion from the middle of the file, you must first load the earlier unwanted portion. Relative files offer greater power in that you can use a record pointer to access a specified portion, but all records must be the same length to compensate.

The alternative approach is to use random access. This method, used by most advanced programs, appears rather daunting because you need to develop an operating system to manage it. However, in reality it is easy to use for simple storage systems.

In this short article I plan to explain the basics of random access and describe the command available to use it. These principles will be illustrated by two example programs. The first is a storage system for adventure data and the second a simple filing system. Much of the information here is given in the handbook accompanying the disk drive but the treatment is a little obscure and the worked examples of little use.

When formatted, floppy disks have a number of concentric strips or tracks. On the 1541 there are 35 such tracks. Each track is subdivided into sectors. The number of sectors varies depending on the position of the track. The outermost track holds 21 sectors and the innermost 17. Each sector holdds 256 bytes of data.

The random access commands allow you to store and retrieve data from these sectors. All you need to do is keep track of which data lies where. The examples given in this article deal with the simple case of records of 256 bytes i.e. one per sector. Longer records require an operating system to remember where they are kept. This is generally necessary in more sophisticated data bases.

Before describing the syntax of the commands, I will explain some abbreviations. I will use the following system of shorthand:

File Number—FN
Device Number—DE
Track Number—T
Sector Number—S
Channel Number—CH
Buffer Number—BN
Buffer Pointer—P
Driver Number—DR

The commands to manipulate data at this level reside in the disk drive so a system must be adopted to access them. Data communication is performed by means of data buffers in the drive. You can either specify a buffer or ask the DOS (Disk Operating System) to select one for you. The buffer is triggered by opening a data channel by use of one of the commands:

OPEN FN,DE,CH,'' BN''—Opens a channel to buffer BN
OPEN FN,DE,CH,'' ''—Asks DOS to choose a buffer

For example: OPEN 2,8,2,'' 3''—Opens data channel 2 using buffer 3
OPEN 2,8,2,'' ''—Opens data channel 2 to any buffer

Disk commands must be accessed via channel 15 in a manner similar to those for formatting the desk etc. The command to open this channel is, for example:

OPEN 15,8,15

You may only work on data in a buffer so more than one step must be carried out. First you must load or save data in the buffer and this must then be stored or retrieved from the buffer. Manipulation of data in the buffer is handled with PRINT and GET commands. In a manner similar to relative files, a buffer pointer is available to specify the byte manipulated. The command to use the pointer has the syntax:

PRINT 15,''B-P''CH,P
e.g. PRINT 15,''B-P''2,133

The example assumes data channel 2 is open and sets the buffer pointer to byte 133. If you were to perform GET 2,B$ after this command byte 133 would be loaded into B$. Similarly PRINT 2,B$ would be byte B$ into the buffer at position 133.

The buffer is read from disk or written to disk by the block read and block write commands. Block read is:

PRINT 15,''B-R''CH,DE,T,S

e.g. to read sector 3 in track 6 from channel 2 to drive 0 use:

PRINT 15,''B-R''2,0,6,3

Block Write is:

PRINT 15,''B-W''CH,DE,T,S

e.g. to write buffer to sector 6 in track 2 from channel 2 to drive 0 use:

PRINT 15,''B-W''2,0,2,6

That is all you need to do the job. Unlike other files, the tracks and sectors to which you write are not protected from overwriting. To prevent this danger, the area must be reserved in the BAM (Block Availability Map) by use of the block allocate command:

PRINT 15,"B-A:"DR;T;S

To deallocate a block use:

PRINT 15,"B-F:"DR;T;S

Even if you do allocate your data, the use of the Validate command will deallocate it, so be warned!

One final tip — always open the two channels early in your routines and don't forget to close them when you've finished. To see the use of all these commands look at the two listings.

The first listing is a simple data filer for adventures and is a logical follow-on from my short series on adventures, published earlier this year. The routine assumes that you want to save location descriptions or messages up to 255 characters long. Each message is therefore stored in its own sector. The first 17 tracks can be used, each with 21 sectors giving storage up to 357 strings. The track and sector corresponding to any given string is easily calculated as in lines 112 and 212. Option 1 reserves the first five tracks. Line 30 can be altered to reserve up to 20 tracks. Option 2 saves the strings and options 3 recalls them. The strings are terminated by ' ' which acts as a sentinel to warn the routines to stop. Lines 215-260 can be used in your adventure to recall and print a string.

Tiny-File in listing 2 uses a similar approach. Each sector holds one record of 256 bytes. Each record is terminated by ' '. A record can be split into fields by carriage returns but the whole record is still only one string.

Option 3 performs three functions:

1. Formats the disk
2. Block allocates the first 20 tracks
3. Stores ' ' in each sector in the first 20 tracks

A sector holding just ' ' is regarded as a null record.

Option 1 allows the entry of a record. You will be prompted for each field and you should terminate a field by pressing RETURN. The data base was originally written to store the contents of disks. Each program on a disk was a field and the complete disk was a record.

Option 2 allows you to examine a specified record. Output to printer is available.

Option 4 performs a simple search for a specified character pattern in a record. For example, assume that record 5 holds the fields:

GORILLA
GIRAFFE
LION

A search for GIRAFFE will step through each record in turn until record 5 is searched. The search will then stop. The search would also find GIR or AFFE. You can easily use the data base to save addresses where the fields could be:

NAME
ADDRESS
PHONE NUMBER

I hope that by studying these listings you will grasp the ideas behind random access. I don't claim that these programs are complex or in any way amazing — they simply do a job in a simple manner.

```
10 REM***************************
20 REM*       TINY-FILE         *
30 REM*                         *
40 REM*       AEW  1985         *
50 REM*                         *
60 REM***************************
70 REM
75 POKE53280,12:POKE53281,11:PRINTCHR$(147);CHR$(144)
80 PRINTCHR$(147)"       DISK FILER V1.3 A WEBB 1985"
90 PRINTCHR$(17)TAB(14)"1. SAVE DATA"
100 PRINTTAB(14)"2. READ DATA"
110 PRINTTAB(14)"3. SET UP DISK"
120 PRINTTAB(14)"4. SEARCH"
130 GETI$:IFI$<"1"ORI$>"4"THEN130
140 ON VAL(I$) GOTO 170,310,540,760
150 REM
160 REM
170 GOSUB930
180 OPEN15,8,15
190 OPEN2,8,2,"#"
200 T=INT(DN/20):S=DN-T*20:T=T+1
210 PRINT#15,"B-P"2;1
220 PRINT#2,O$
230 PRINT#15,"B-W"2;0,T,S
240 GOSUB980
250 CLOSE2:CLOSE15
260 POKE781,21:POKE782,5:POKE783,0:SYS65520
270 PRINTCHR$(18)"PRESS ANY KEY TO RETURN TO MENU"
280 GETI$:IFI$=""THEN280
290 GOTO80
300 REM
310 OPEN15,8,15
320 OPEN2,8,2,"#":P=1
330 PRINTCHR$(147):INPUT"RECORD #";DN
340 FL=0:PRINT:INPUT"OUTPUT TO PRINTER (Y/N)";I$:IFI$="Y"TH
ENFL=1
350 IFFL=1THENOPEN4,4
360 PRINTCHR$(147)"RECORD #";DN
370 PRINT"[DOWN]CONTENTS:"
380 IFFL=1THENPRINT#4,"RECORD";DN:PRINT#4:PRINT#4,"CONTENTS
:":PRINT#4
390 T=INT(DN/20):S=DN-T*20:T=T+1
400 PRINT#15,"B-P"2;P
410 PRINT#15,"B-R"2;0,T,S
420 GET#2,O$:IFO$="@"THEN450
430 PRINTO$;:GOSUB 1010:P=P+1:PRINT#15,"B-P"2,P
440 IFP<256THEN420
450 IFP=1THENPRINTCHR$(18)CHR$(17)"NULL RECORD":IFFL=1THENP
RINT#4,"NULL RECORD"
460 IFFL=1 THEN PRINT#4:PRINT#4,"---------------------------
-------------"
470 POKE781,21:POKE782,5:POKE783,0:SYS65520
480 PRINTCHR$(18);"PRESS ANY KEY TO RETURN TO MENU"
490 GOSUB980
500 CLOSE15:CLOSE2:IFFL=1THENCLOSE4
510 GETI$:IFI$=""THEN510
520 GOTO80
530 REM
540 PRINTCHR$(147)"THIS WILL ERASE THE CONTENTS OF THE DISK
"
550 INPUT "DISK NAME";NA$
560 INPUT "DISK I.D.";ID$:ID$=LEFT$(ID$,2):O$="NO:"+NA$+","
+ID$
570 PRINTCHR$(17)CHR$(17)"ARE YOU SURE? (Y/N)"
580 GETI$:IFI$<>"Y"ANDI$<>"N"THEN580
590 IFI$="N"THEN80
600 OPEN15,8,15,O$
610 OPEN2,8,2,"#"
620 PRINTCHR$(147)"THIS WILL TAKE 3 TO 4 MINUTES"CHR$(17)
```

```
630 PRINT"GIVING ROOM FOR ABOUT 350 RECORDS."
640 PRINT"THE REMAINDER OF THE DISK MAY BE USED   FOR NORMA
L PROGRAM STORAGE"
650 PRINTCHR$(5)CHR$(17)"                ***WARNING***"
660 PRINTCHR$(17)CHR$(144)"  ANY ATTEMPT TO VALIDATE THE DI
SK MAY"
670 PRINT"          ERASE THE DATA BASE":O$="@"
680 PRINT#15,"B-P"2;1
690 FORT=1TO17:FORS=0TO20
700 PRINT#15,"B-A:0",T,S
720 PRINT#2,O$
730 PRINT#15,"B-W"2;0,T,S
740 NEXTS,T
750 CLOSE2:CLOSE15:GOTO80
760 PRINTCHR$(147):INPUT"FIELD NAME";FI$
770 OPEN15,8,15
780 OPEN2,8,2,"#":FORDN=1TO350:P=1:M$=""
790 T=INT(DN/20):S=DN-T*20:T=T+1
800 PRINTCHR$(147)"RECORD # ";DN
810 PRINT#15,"B-P"2;P
820 PRINT#15,"B-R"2;0,T,S
830 GET#2,O$:IFO$="@"THEN850
840 M$=M$+O$:P=P+1:PRINT#15,"B-P"2,P:GOTO830
850 IFM$=""THENPRINT:PRINTCHR$(144)CHR$(18)"NULL RECORD":FO
RD=1TO200:NEXT:GOTO89
0
860 FORJ=1TO LEN(M$)-LEN(FI$)
870 IFFI$=MID$(M$,J,LEN(FI$))THENPRINT:PRINTCHR$(18)"FILE F
OUND":PRINT:PRINTM$:G
OTO910
880 NEXTJ
890 NEXTDN
910 CLOSE15:CLOSE2
920 GOTO260
930 O$="":PRINTCHR$(147):INPUT"RECORD #";DN
940 INPUT"FIELD NAME (* TO QUIT)";FI$
950 IFFI$="*"THENO$=O$+"@":RETURN
960 O$=O$+FI$+CHR$(13):GOTO940
970 RETURN
980 INPUT#15,EN,EM$,ET,ES
990 POKE781,23:POKE782,0:POKE783,0:SYS65520
1000 PRINTCHR$(18)"DISK STATUS: ";EN;EM$;ET;ES:RETURN
1010 IFFL=1THENPRINT#4,O$;
1020 RETURN
```

```
1 POKE53281,12:POKE53280,12:PRINTCHR$(144)CHR$(147)
2 Y=5:X=13:GOSUB63300:PRINT"ADVENTURE FILER"
3 X=X-4:Y=Y+2:GOSUB63300:PRINT"***********************"
4 Y=Y+1:GOSUB63300:PRINT"* 1. ALLOCATE BLOCKS *"
5 Y=Y+1:GOSUB63300:PRINT"* 2. SAVE BLOCKS     *"
6 Y=Y+1:GOSUB63300:PRINT"* 3. READ BLOCKS     *"
7 Y=Y+1:GOSUB63300:PRINT"***********************"
8 PRINTCHR$(5):Y=Y+2:X=13:GOSUB63300:PRINT"SELECT OPTION":P
RINTCHR$(144)
9 GETI$:IFI$<"1"ORI$>"3"THEN9
10 ONVAL(I$)GOTO12,90,200
12 OPEN15,8,15
20 OPEN2,8,2,"#"
30 FOR T=1TO5
35 FORS=1TO20
40 PRINT#15,"B-A"0;T;S
50 GOSUB63000
52 Y=22:GOSUB63300:PRINT"                         "
53 Y=22:GOSUB63300:PRINT"TRACK"T" SECTOR"S
60 NEXTS,T
70 CLOSE15:CLOSE2:GOTO1
80 REM
81 REM
90 GOSUB30000
96 T=INT((MN)/20):S=MN-T*20
100 OPEN15,8,15
110 OPEN2,8,2,"#"
111 FOR MN=1TO3
112 T=INT((MN)/20):S=MN-T*20:T=T+1
115 PRINT#15,"B-P"2;1
120 X=0:Y=22:GOSUB63300:PRINT"                         "
130 X=0:Y=22:GOSUB63300:PRINT"WRITING MESSAGE"MN " TO TRACK
"T" SECTOR"S
140 PRINT#2,O$(MN)
160 PRINT#15,"B-W"2;0,T,S
170 GOSUB63000:NEXT
180 CLOSE2:CLOSE15:GOTO1
181 REM
182 REM
200 OPEN15,8,15
210 OPEN2,8,2,"#":P=1
211 INPUT"MESSAGE NO";MN
212 T=INT((MN)/20):S=MN-T*20:T=T+1
215 PRINT#15,"B-P"2;P
220 PRINT#15,"B-R"2;0,T,S
230 GET#2,O$:IFO$="@"THEN260
240 PRINTO$;:P=P+1:PRINT#15,"B-P"2,P
250 GOTO230
260 CLOSE2:CLOSE15:END
30000 O$(1)="STANDING BY A LOW BUILDING ON THE SLOPE OF A H
ILL. A WHIPPET SITS "
30010 O$(1)=O$(1)+"NEARBY EATING A BOWL OF FOOD. IT LOOKS L
IKE RAIN.@"
30020 O$(2)="WE'RE ENTERING A LONG WOODEN BUILDING.  A RATH
ER EVIL LOOKING "
30030 O$(2)=O$(2)+"TRANSVESTITE IS   SITTING IN A ROCKING C
HAIR@"
30040 O$(3)="WE'RE ENTERING A HUGE CAVERN.A THIN MISTDRIFTS
 FROM VENTS IN THE"
30050 O$(3)=O$(3)+" WALLS.LONG     STALACTITES HANG FROM.TH
E ROOF GIVING   THE "
30060 O$(3)=O$(3)+"ROOM A BIZARRE ATMOSPHERE.THE AIR ISCHIL
L AND DAMP.THERE IS"
30070 O$(3)=O$(3)+" A NARROW TUNNEL ENTRANCE TO THE NORTH.@
"
39999 RETURN
63000 INPUT#15,EN,EM$,ET,ES
63010 Y=23:X=0:GOSUB63300:PRINT"                         "
63020 Y=23:X=0:GOSUB63300:PRINTEN;EM$,ET;ES
63030 RETURN
63300 POKE781,Y:POKE782,X:POKE783,0:SYS65520:RETURN
```

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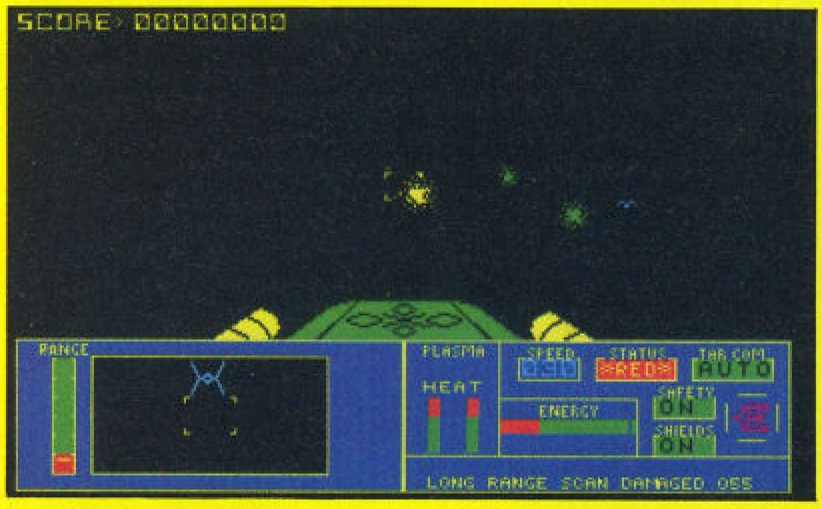
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Mat is the sole defender of the satellite network which supplies power to the mines and must use all his skill to maintain the flow of power in the face of the Myon fleet. The ship he commands is the Centurian II which is armed with both laser and plasma cannon, warp and ion drive, plus a comprehensive range of guidance systems and defence mechanisms.

The player must control the ship using a fair range of cursor keys but this situation can be alleviated slightly by the use of a joystick.

Defensive shields and automatic shutdown systems can be toggled on and off but why anyone would want to turn off the defence shield, I cannot imagine. The shutdown safety device is a guard against pilot error and will prevent overheated weapons from exploding or abort a warp if the front shield is damaged.

The operation quadrant can be viewed to ascertain where the enemy lies and locate the most vulnerable satellites in the grid. As each satellite is damaged its colour darkens from white to red. The satellite grid is four units deep and each row can only supply power if all of the satellites in that row are operational. The amount of power supplied is related to the weakest unit in a particular row but at the end of each attack wave repairs can be made and satellites moved to make the most of the dwindling resources available.

Once the enemy is located the quadrant display can be used to calculate the angle and distance from your current position and the warp drives will carry you into battle position. By switching to the battle computer, locating and approaching the enemy can be affected by using the automatic location indicator and the ion engines.

The ensuing battle is fairly standard but the graphics give a particularly good 3D display which makes you feel that the enemy is approaching at speed. Each wave of attacking aliens have different characteristics and firing abilities, the new wave being more cunning and faster than the previous one. Incoming plasma bolts must be dodged but I did find that using the ship to ram the enemy in the early stages gave a second, if somewhat drastic, means of defence.

Damage can be repaired between battles by allocating one, or both, of the ship's droids to the stricken area. Repairs take time and that is why ramming can only be used against the first two attack waves. The longer you retire for repairs, the more damage can be done to the satellite net. Repairs can also be undertaken between attack waves and these are done more quickly. An allotted time for the repairs is given and, on selection of the area for action the clock ticks down as the amount of damage decreases.

An excellent feature of the game is the load/save facility so that you can either continue later or go back a stage if an error of judgement was made. You only have one ship so this form of insurance is most valuable if you want the highest possible score.

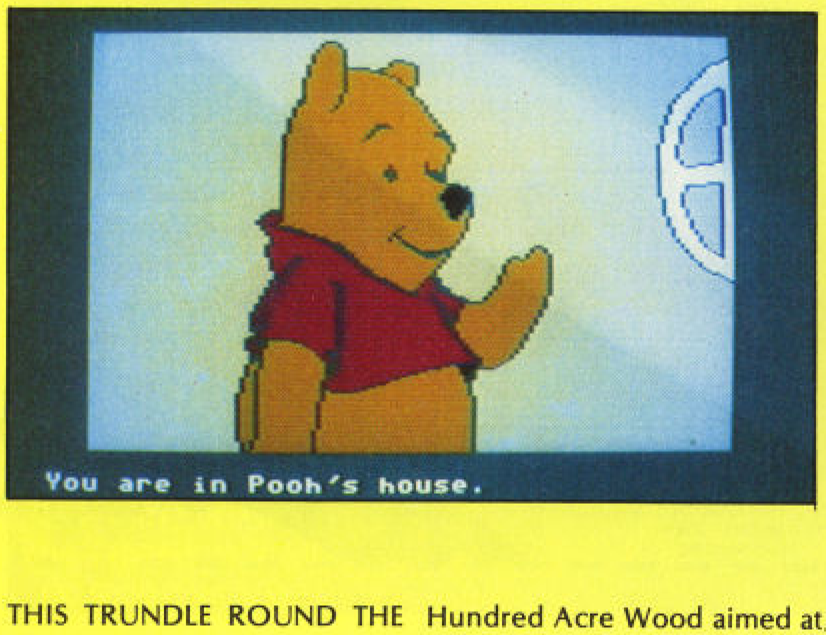
Of the Startrek genre, this is one of the best games I have encountered. The graphics are very good and the sound is adequate though not stunning. If you're not tired of this kind of simulation, you won't find a better version.

WINNIE THE POOH IN THE HUNDRED ACRE WOOD

Kids! £12.95 disk

R.C.

Originality 6 Playability 7 Graphics 8 Value For Money 8



THIS TRUNDLE ROUND THE Hundred Acre Wood aimed at the seven and over age group provides a peril-free apprenticeship for would-be adventurers. No goblins lurk round the corner in this one, not even a Heffalump or a Woozle. The worst thing that can happen is that the blustery wind can blow up any minute and scatter the objects you're looking for.

Eeyore, Tigger and the rest of Pooh's pals have all lost something and your task is to find and return the items to their rightful owners.

There is a detailed map and lashings of information on the personal habits of all.

As you saunter through this adventure exploring all the homes you'll discover finding the objects is more difficult than it first appeared as a few red herrings and dead ends have been included. These are pointed out by rather cutsie attempts at humour.

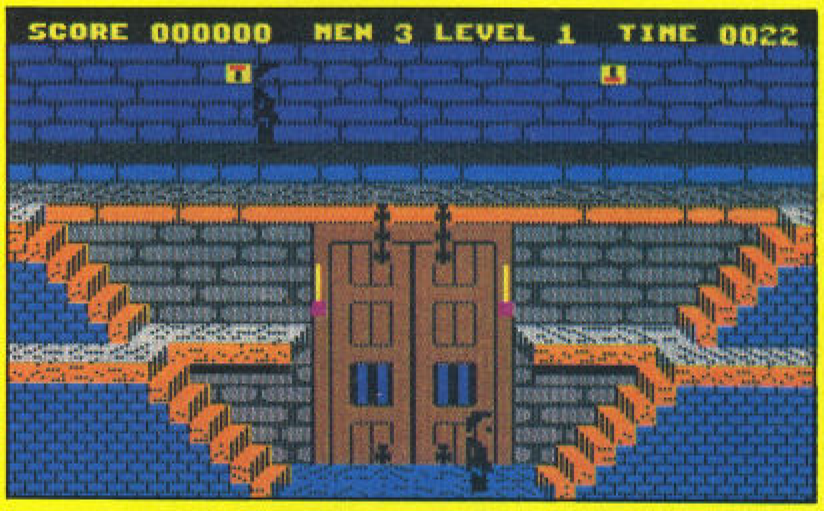
The full-colour graphics are excellent and the game is diverting enough to give embryonic adventurer hours of gentle aggravation.

Winnie the Pooh offers an amiable and absorbing jaunt and is designed to foster educational side effects in reading, problem solving and map comprehension. Buy it – or they'll send Tigger round.

SCHIZOPHRENIA
Quicksilva £7.95

E.D.

Originality 9 Playability 8 Graphics 6 Value For Money 7



DR JEKYLL AND MR HYDE were two facets of one man's personality but what would happen if both of them existed at the same time? This is precisely what has happened in Schizophrenia. Alphonse T. Nurd is a cleaner who splits his persona whilst playing with an Atomic Particle Separator instead of doing his job. The result is two Nurds, one good and the other bad.

For the sake of clarity I will call the original Alphonse Al and his alter-ego Nurd.

Al knows that there is a Recombination Chamber somewhere in the lab but he must lure Nurd there first. Everything that Al does, Nurd tries to undo which makes the game a unique experience.

The first screen is one of the most difficult to master because Nurd is there all the time. Al must open the door to the laboratory by undoing four bolts and pulling a lever. Nurd wanders about unfastening bolts, pushing levers and fiddling about with a timer switch and score counter. If Al should meet his other self, Nurd gives him a swift punch which sets Al hopping about the screen. Similarly, if he falls off the stairs or the balcony he somersaults as he crashes to the floor.

Once you work out a sequence it becomes relatively easy to complete this stage as long as you keep your wits about you.

The next four screens rely on your powers of deduction, timing and dexterity for success. Nurd only appears occasionally and in some cases you can keep him out of the way altogether until the crucial final moments.

In Area Two you have to move yellow boxes to the top right hand corner of the room using lifts. Unfortunately, some of the lift controls can only be reached by standing on stacked boxes so careful planning is necessary if Nurd is not to undo your good work with a swift kick.

Lift cleaning is the object of Area Three ending up with all of the lifts on the ground floor. Working out how to get the lifts there at the same time is the major problem and preventing Nurd from dirtying them up again adds to the difficulty.

Before reaching the Recombiner the lights must be turned on in Area Four. This is done by setting a row of switches in the correct combination of off and on positions. In one of the alcoves lurks Nurd and he will stay in the room until the light goes on, so you have to find out where he is and take action accordingly.

Area Five is Al's goal and his greatest challenge. He must lure Nurd into the Recombiner after having set the generator switches, the X/Y co-ordinates of the unit and the power. Nurd is not too keen on this and will do his utmost to upset the plan.

Schizophrenia is unlike any game I've played. The graphics are interesting, particularly Al's silly walk, but all this is secondary because most of the action takes place in your mind. No two ways about it, I'll buy a couple of copies for both of me.

IMHOTEP
Ultimate £9.95

E.D.

Originality 8 Playability 9 Graphics 8 Value For Money 8



IMHOTEP THE WISE, SERVANT of the god Zoser, Pharaoh of Egypt has been entrusted with a mission to save the land from famine. So fierce is the hunger of the people that he must seek guidance from Thoth, the keeper of knowledge.

In his wisdom, Imhotep knows that the secret of how to make the Nile live again lies in the hands of a beautiful princess who holds the books known as the Souls of Ra. In his foolishness Imhotep has chosen to seek Thoth to guide him to the princess.

The journey is a hazardous pathway through the land of the Jawi nomads. Mounting a giant vulture, Imhotep starts his journey and we present day mortals lend a hand.

Many of the Jawi ride on vultures like Sunday drivers and fly across the sky but some are true warriors with fast mounts and deadly aim. It's rather like driving the wrong way down a motorway. The action is frantic, like playing defender without recourse to a smart bomb.

Soon the catapults add to your problems by hurling boulders from the shelter of the pyramids. Once through this deluge a hail of thunder bolts rent the screen. With all five lives expended and my joystick streaming with perspiration I reached my limit.

Ultimate intimates that beyond this point there are mazes to negotiate and the list of features is impressive.

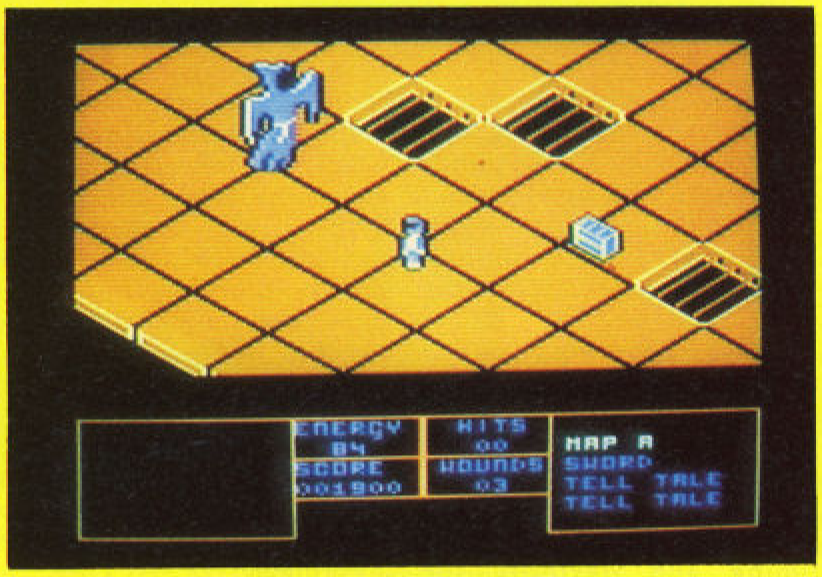
Great scrolling graphics and superfast action make this an infuriatingly addictive game.

WIZARDRY

The Edge £7.95

E.D.

Originality 7 · Playability 8 · Graphics 9 · Value For Money 8



"DRINN WAS QUITE SURE OF one thing, that he should never have contemplated becoming a sorcerer!". So begins the booklet which accompanies this game and, as you lead him from room to room in the Castle of Illusions, it soon becomes clear why he feels this way.

The Loremaster demands that each novice sorcerer undertakes the quest to find the Prime Elemental hidden in the depths of the castle and now it is Drinn's turn to take this final test of his fighting and spell-casting powers.

Before the quest can be completed there are several puzzles to be solved as Drinn progresses towards his goal.

The castle is represented in 3D looking from a viewpoint very similar to that used in Zaxxon. The only room you can see is the one you are currently occupying but doors are quite clearly indicated. Behind the doors lurk a myriad of monsters such as winged skulls, minotaurs and scorpions, but only one creature defies Drinn's armoury of magic and steel and guards the way towards the inner sanctum.

Somewhere in the maze is a spell which will enchant this guardian and allow Drinn to pass but much searching and spell casting is needed first.

As Drinn ventures forth he finds chests which may contain extra spells but occasionally they contain evil surprises. Spells can usually only be used once so care must be taken to direct them precisely towards their target or a vital spell may be lost forever and the quest foiled.

One spell which it is essential to keep in good supply is the healing spell. This replenishes our hero's waning strength after battling with the apparitions in the castle. The screen display shows Drinn's current state of health as well as a scrolling list of the spells he possesses. Care must be taken to have a suitable touch of magic near to hand when entering a new room and you can find out what the best one will be by entering the room briefly and listening to the musical clue.

Another spell which will be needed is called 'tell tale' and this is the help facility which will cause a pair of moving lips to appear while a cryptic clue appears on the screen. Success with a spell causes Drinn to turn purple but if you use a black and white monitor you will have to watch the screen very closely to see any change at all, but it's almost worth buying a colour monitor to play this game!

Sometimes a spell cast in one room has no apparent effect but the colour change indicates that something has happened somewhere. Returning to the room where the spell was found usually reveals a surprise.

The first guardian to be encountered is a minotaur and the booklet describes how to solve the problem just to get you started. From the second phase on you're entirely on your own.

The music and the graphics in this game are very good indeed, though I did find the movements difficult to master at first. Spell casting caused similar problems but all of the rooms have flagstones and the matrix formed can be used as a guide.

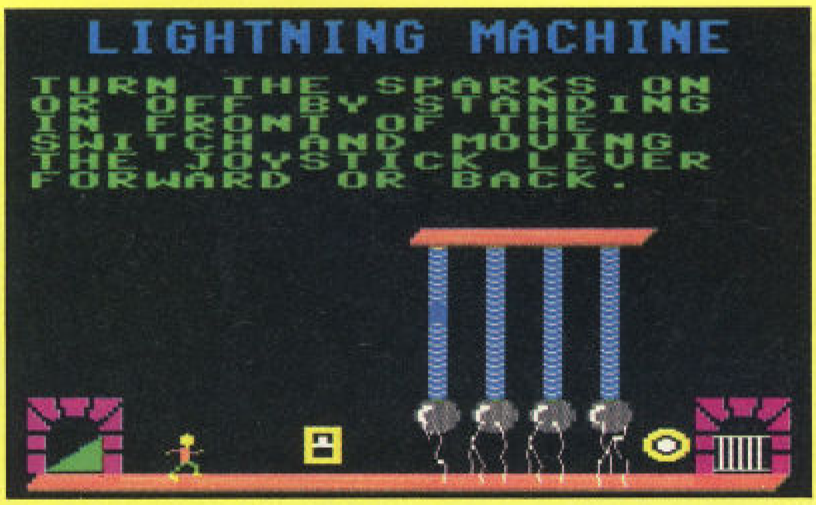
The principal aim is to preserve your spells for times when they may be really needed. Often foes can be outrun in the early stages and the skilful use of a sword can dispell some of the less powerful creatures. The puzzle element makes the game like a series of problem solving games and their solution is both engrossing and enjoyable.

THE CASTLES OF DOCTOR CREEP

Ariolasoft 9.95

J.L.

Originality 9 · Playability 7 · Graphics 8 · Value For Money 8



DEFINITELY THE BEST FEATURE of this platform game is that two players can assist each other against the castle's destructive forces, rather than fight each other.

A word of warning, though, your 'friend' may think it is much more fun to help you only up to a point whereupon he may 'stab you in the back'.

Tread carefully through the corridors lest you wake a slumbering Frankenstein or a murdering mummy. Matter transmitters can flash you across a room in an instant, but beware you don't land within range of a ray gun, which can zap you right back to the entrance of the castle.

The player must load the scenario for each castle separately, by rewinding the tape to the beginning of side two and reloading it. The menu presents the castles in order of difficulty and offers you the option of either an unlimited number of lives or only three.

The challenge is to find the exit door and leave the castle in the quickest possible time. A colour-coded screen mapping out the players' progress is shown every time a life is lost. This diagram also shows the position of the entrance to the next room.

The inlay mentions piped music but the only sound emitting from the copy I have is occasional high and low toned beeps. This is a stimulating game which will keep anyone's interest for hours.

ACTION REPLAY

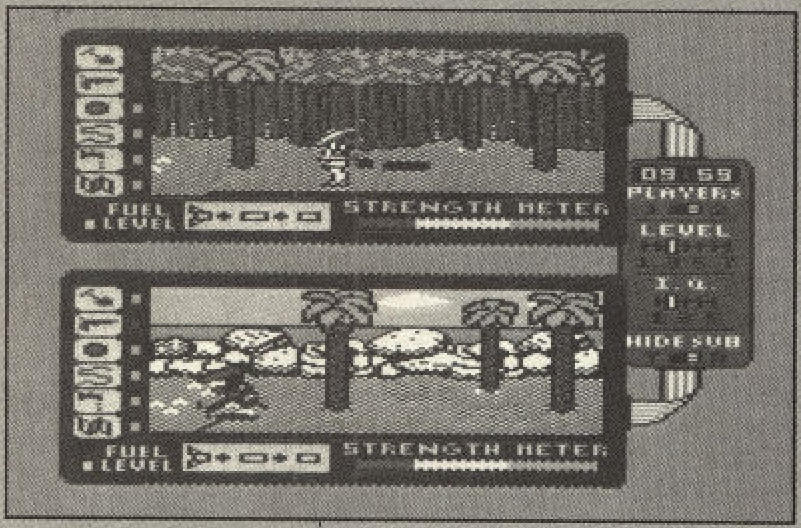
Originality Playability Graphics Value For Money

SPY V SPY: THE ISLAND CAPER

Beyond £9.95

E.D.

Originality 6 Playability 8 Graphics 8 Value For Money 8



THOSE FIENDISH SECRET agents from the pages of Mad magazine are at it again.

In the first Spy v Spy game they were restricted to searching a building but now they have been let loose on a volcanic desert island. This time the enemies must fight to find a hidden missile. Speed is of the essence because the volcano is due to erupt and cover the island in molten lava. As usual our heroes seem totally oblivious to the danger and are more intent on each other's destruction as they squabble for possession of the three parts of the missile.

The most impressive feature of the game is the simultaneous action screens. The display is laterally split and one spy is controlled in the top sector whilst the other scurries about on the lower display.

Inventive as ever, the spies have discovered how to use the resources of the island to make destructive anti-personnel weapons. Coconut bombs, snares and pits complement the natural hazards of quicksand and shark infested waters and the unnatural hazards of swordplay and gunfire.

Central control is exercised by the skilfull use of the Trapulator which tells you what objects you are carrying, your current strength and the time left before the eruption begins. All functions are controlled by your joystick and you have to be pretty dextrous if you are going to defeat the computer control option.

At first I found it best to select the two player option so that I could practice digging pits and setting all of the other traps, as well as finding the missile parts and screwing them together.

The fact that the other spy does not move makes it awkward when you both occupy the same bit of the island. Such is the rivalry of the two spies that they would rather fight than search. Since both of these actions require you to press the fire button, you cannot search when you are together. This means moving, or killing, the second spy while you search his 'home' area.

Once you have mastered the skills of the game, you are ready to compete. Each spy sets about the business of finding the missile parts and the necessary components for setting booby traps to slow down or eliminate his opponent. Coconut bombs, napalms, swords and guns can be used as found though some of the bullets in the guns may turn out to be blanks. Other traps have to be constructed.

A pit can only be made if you find a spade and the pit can be more effective if it is turned into a punji pit by placing a sharpened stake at the bottom. Snares can be rigged up to a palm tree if you find the rope to do it with and the unsuspecting spy will hang upside down from the tree for several seconds if caught. To add to all this nastiness, bombs and snares can be set over buried missile parts but remember my warning about the indiscriminate nature of booby traps, and also remember to watch what your opponent is doing and where he is doing it.

When all three parts of the missile are in your possession, you must locate your escape submarine which will surface off the island and then rendezvous with it by wading out to sea. This can be difficult because you submerge and lose strength. Make sure you are feeling healthy enough to attempt it and look out for sharks.

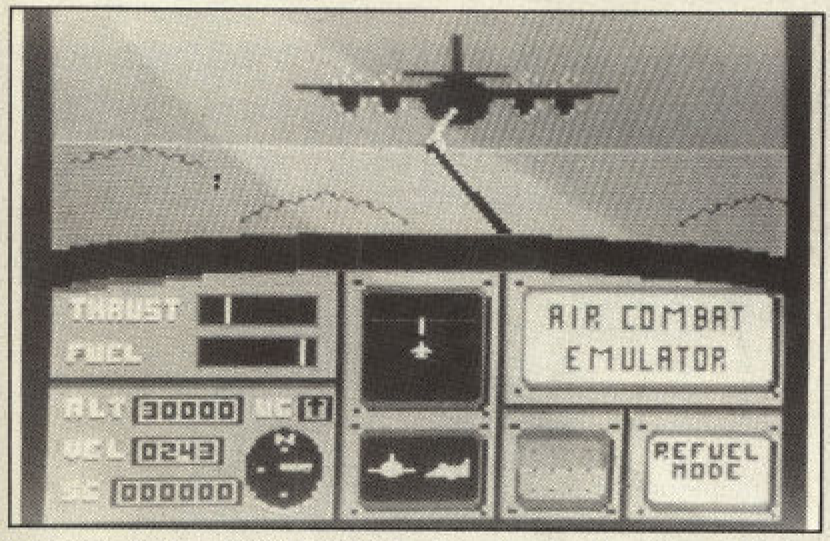
The Island Caper is extremely enjoyable to play because of the superb cartoon graphics and makes an excellent follow up to its predecessor.

A.C.E.

Cascade £9.95

E.D.

Originality 6 Playability 8 Graphics 9 Value For Money 8



ACE IS A SIMPLE SIMULATOR which involves a strategic war game and owners of a C-16 will already be familiar with the earlier version.

You have to select the kind of mission and the armaments which you think will be required.

Getting into the air is simply a matter of attaining the correct speed, pulling back on the joystick and raising the undercarriage. Now you have to locate the enemy by consulting the map which shows all the advancing enemy forces.

Using the joystick and screen display, it is an easy matter to set your course to intercept the enemy as long as you can read a compass. Occasionally switching to the map ensures that you're on the correct path.

Refuelling can be achieved by either landing at an allied landing strip or by rendezvousing with a tanker in mid-air. Of the two, the tanker is the trickiest because you have to match height and speed to hit the trailing refuelling nozzle, and that's after you've found the wretched thing!

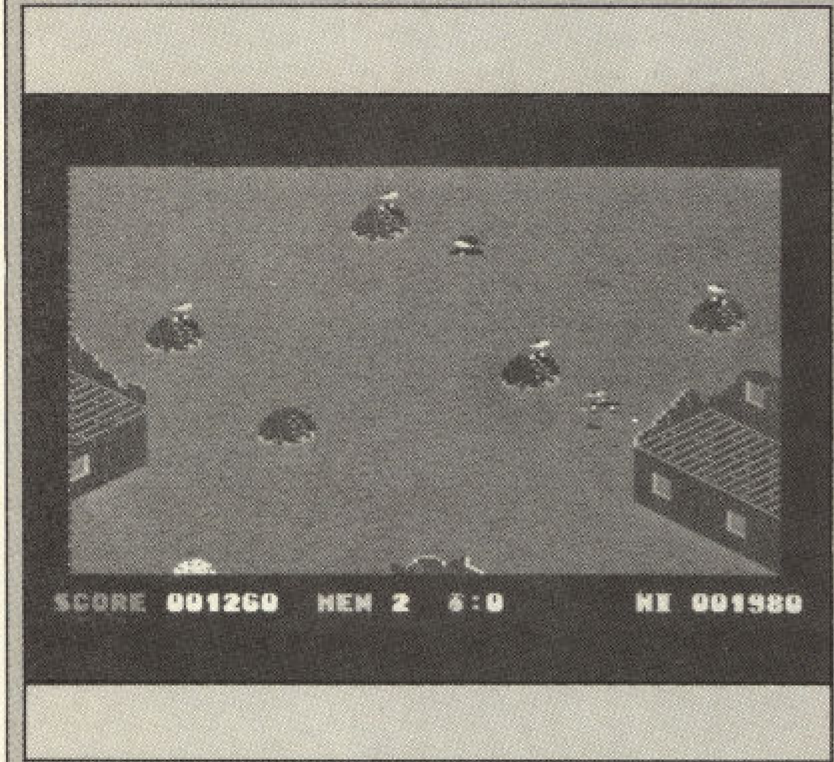
Combat with the enemy relies on fast reactions, especially in air to air combat. Everything seems inclined to fire back but with machine guns blazing and heat seeking missiles flying, the battle soon becomes so absorbing that you have to remember to keep an eye on your height and speed.

WHO DARES WINS II

Alligata £7.95

E.D.

Originality 5 Playability 7 Graphics 7 Value For Money 7



IN THIS GAME YOU MUST pretend to be a John Wayne-style one-man army as you fight your way through eight battlefields with guns blazing and grenades flying.

You have volunteered for a suicide mission to liberate your lost comrades-in-arms from the clutches of the enemy. To do this means penetrating deep into their territory and facing whatever problems they may throw at you, armed only with an eternally loaded rifle and a dwindling supply of hand grenades. Luckily, the enemy has left cases of grenades lying around which will replete your stocks.

The enemy is always to the north (up the screen) and once the screen scrolls up a line or two there is no going back.

At first the enemy only has the same weapons as yourself, but soon you start to face mortar fire and armed pill boxes, which can be overcome without the use of a grenade but a well-placed lob means life becomes much easier.

Every now and then a prisoner is facing a firing squad and his freedom lies in your hands. A carefully aimed shot will despatch the guard and award a bonus mark. This is the theory but in practice I found that my little barnstormer seemed to be of the opinion that a dead comrade tells no secrets and often the guard escaped while the prisoner performed his death throes pirouette!

Physical barriers also cause problems. The soldiers onrush is punctuated by greedy ponds and quicksand. Negotiating a pathway through these obstacles, under fire, is difficult but not as problematic as passing under the roads which criss-cross the landscape.

Frequently a barbed wire border is guarded by a gun emplacement and if your soldier has used up all of his grenades, the only way to advance is to grit your teeth and charge. As you pass into the tunnel your soldier disappears from sight and careful manipulation of the joystick is necessary to avoid the incoming bullets.

A successful charge inevitably brings you to the door of a sentry post which opens to disgorge a horde of troops under the command of an heroic captain who makes a bee-line off the screen to safety. If you can shoot him before he goes you are rewarded with a bounty of 1250 points, but even this high bounty is sometimes worth sacrificing in the face of so many other troops homing in.

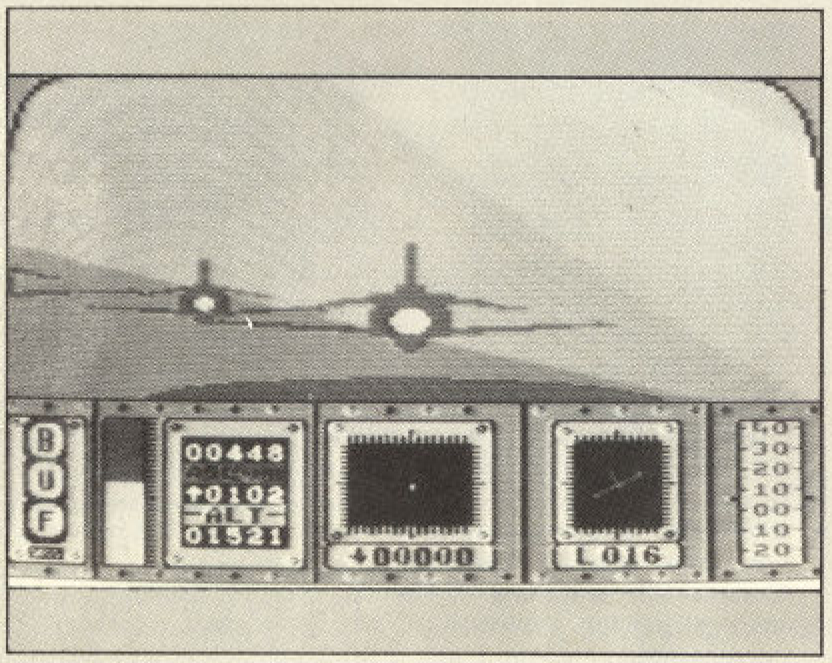
If all this wasn't sufficient to keep you busy, an extra bonus can be scored by destroying a dinghy escaping across a river and the occasional plane strafes its way across the screen.

Once all the enemy has been killed you are allowed to advance to the next of the eight levels. Success at level eight takes you back to the opening screen but the enemy has taken new heart and fights more ferociously.

RED ARROWS

Database Software 6.95

Originality 7 Playability 4 Graphics 4 Value For Money 5



FLYING WITH THE RED Arrows must be the dream of many people. Now you can gain the experience on your C64.

Unfortunately the reaction of the plane is very slow and clunky.

Eight of the formations which the Red Arrows use in their displays are represented in the game and you are Red 8. This means that you can use your radar to shadow Red 9 who is always in the mirror image position of your jet.

Menus give a wide range of options to help you learn how to fly and each manoeuvre can be tackled individually until you feel ready to join in a full display.

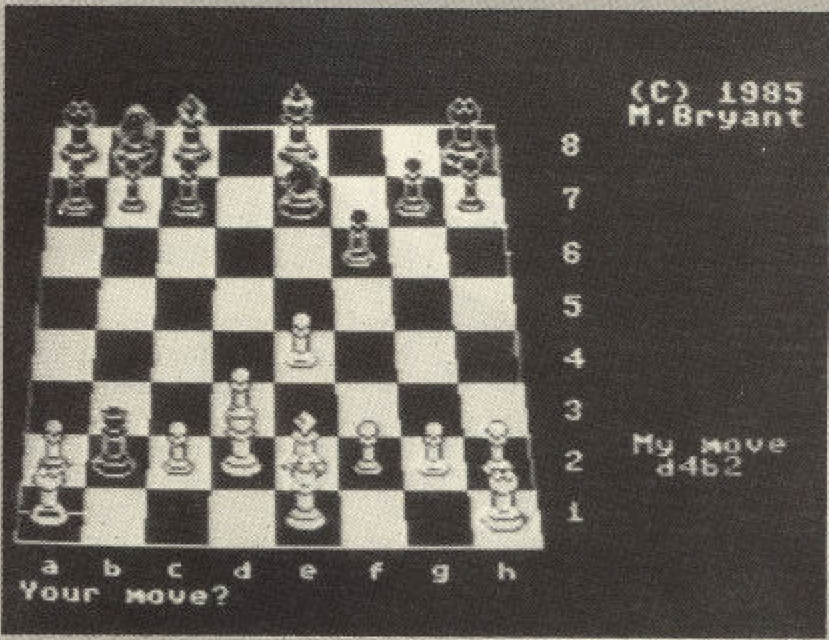
It is a pity that the screen display occasionally seems at odds with the action because of the slowness of the display. It is such a good simulator in terms of facilities. Airbrakes, undercarriage, elevators, ailerons, rudder and thrust are all under your control but you can opt to have some of the pressure taken off you by choosing an auto mode.

The program is the only formation flight simulator available and as such will probably sell quite well, which is good news for the charities nominated by the Red Arrows to receive a share of the proceeds.

COLOSSUS CHESS 4

CDS Software £9.95 cassette £14.95 disk **P.T.**

Originality 6 · Playability 8 · Graphics 7 · Value For Money 7



WITH THE WORLD CHESS championships taking place, interest in this game of mental stamina is keener than ever before. Using a chess computer is probably the best way to learn the game and Colossus Chess 4 is top of the tree among those programs presently available.

Chess without doubt, is the most skilfull game of them all, because there is no element of luck or chance. The best player should always win. Therefore, when looking for a chess program, the one to choose is the one that makes you a better player and improves your game. A chess program also removes the problem of finding human opponents of your standard.

Colossus 4 allows you to choose the strength of the computer's play by adjusting the time you allow it to think out its moves. The longer you allow the machine to think, the better its moves become.

The game is easy to play and the pieces easy to control, especially since a three dimensional board has now been added.

The program has a perfect understanding of all the rules including under-promotions, the 50 move rule and all draws by repetition.

While waiting for the computer to move, you can observe its current thinking by pressing the space bar, see a hint move and have the computer's assessment of the state of play.

Colossus 4 examines about 300 positions per second. Whilst you are working out your move, it assumes your next move and works out its reply. However it only gets about one in three correct.

You can set up full tournament mode, or specify an average time per move or even play a game against the clock. For postal chess players there is an infinite mode and a problem solving mode – to help with the chess problems in the daily papers.

The program has other useful features, such as: Allowing you to retrieve your position if you make a mistake (or want to cheat!): letting you play for either side, or watching the computer play itself. After the game you can watch an action replay, or your own victory or see where you went wrong.

Those with masochistic tendencies can try out a game of invisible chess.

One of the new features is the ability to set up quantity parameters. For experienced players, this makes the game far more interesting. Colossus also has a bank of about 300 openings so you can try out many different tactics. Also the new "Draw score" allows you to make the computer try very hard for a win rather than settling for a draw as many programs do.

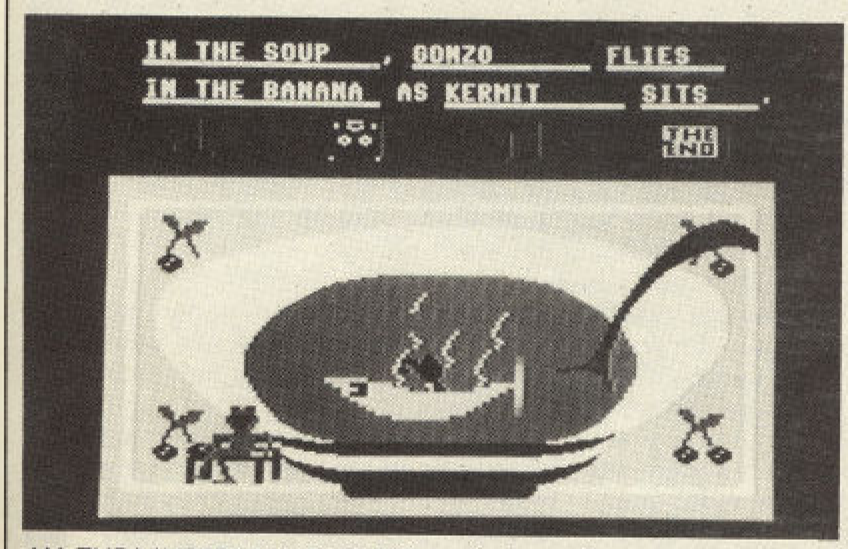
If you want a challenging game then try Colossus 4, although experienced players will find that they still have to allow a long time for moves to get a demanding game.

However, if you own Colossus 2, then there is little point in changing over to the new version as the differences do not really justify the expense.

KERMIT'S ELECTRONIC STORY MAKER

Kids! £9.95 cassette £12.95 disk **R.C.**

Originality 6 · Playability 6 · Graphics 8 · Value For Money 5



ALL THE MUPPET FAVOURITES are included plus the real star of the show, an animated banana.

The graphics are bright and some amusing combinations can be created with bouncing bathtubs in a bowl of soup.

Sound effects and music can be added but one disadvantage is that scenes are self contained and you can't make a continuous story line.

Once the child has worked through the wacky permutations the program has limitations but as an introduction to new vocabulary and simple sentences Muppet-aided learning is a breezy alternative.

If you are willing to entrust your child's education to a showbiz amphibian turned academic and have him or her interacting with the likes of Gonzo to construct scenarios featuring flying bananas this could be the program for you. One drawback however, is the price.

It's undoubtedly a slick package high on entertainment value but perhaps too restricted in educational terms to merit the price tag for cost conscious parents.

Personally I think this fun, fun, fun approach to the three R's has gone far enough. When is some visionary software house going to sign up Janet and John?

Missives

This month we begin a regular letters page where you can send us your ideas, views, moans and, of course, compliments! There's also £10 for the month's star letter.

Print Hint

Why is it that all computer magazines want a computer printout with any submitted program?

I write a lot of programs and would love to send some of them to you and hopefully have them published. However, I can't afford a printer and therefore can't get a printout of the program.

Julie Smith, Newtownards

I would like to make it clear that we don't insist on every program having a listing with it. Please do send your programs to us anyway.

The reason that we ask for a listing to be included if possible is so that we can judge how long the program will be when we print it. It also serves as a reference if we get any queries from people who type the program in.

Stay Sharp

On reading the November 1985 edition of Your Commodore I was delighted to read Stuart Cooke's comment stating that having joined forces with Your 64, you will be bringing us the best Commodore magazine around.

Your 64 began its life as a practical and informative magazine. Its deterioration into an overpriced games review, seemingly written by children for children, was rapid!

I have noticed with several, now defunct magazines, that the first stage of their decline was marked by an increase in games reviews and a corresponding decrease in informed editorial.

The second stage was heralded by letters of complaint about the content of the later issues. The reply to these has become infuriatingly predictable – the favourite being "we can't publish if you don't send us". Editors would do well to remember that we pay for a magazine to inform us or entertain us, to provide us with a service. Customer participation is all very well but should not be to provide the material.

I hope that Your Commodore continues to be a good read and does not degenerate into another fab mag with fab games reviews, brill banter and high scores.

Eric Pickering, Corwen

I am pleased to say that Your Commodore will certainly not 'degenerate into another fab mag', in fact we hope that quite the opposite will happen. Our aim as an editorial team is to produce a well balanced informative magazine for those people who want to do more than just play games on their Commodore computer.

As for your comment about submitting articles to the magazine, I am afraid that it is only too true of any magazine that 'we can't publish if you don't send us'. You, the readers, are the ones that are discovering new things about your computers or writing programs that you think will be of use to other people. How can other people hear about these things if you don't send them to the magazine? Don't forget we do pay for all material that we use.

Merger Moans

Before Your Commodore and Your 64 were joined I used to purchase Your 64. Looking through the new mag I was deeply shocked – I couldn't see anything on hints and tips, no cheats or POKEs also there was no software chart.

When I glanced through the new magazine I noticed that most of the pages were given up to listings. Not that I mind listings, but is it really necessary to have that many or is it just a cheap way of filling up pages?

I also noticed that you were giving away 10 Compunet modems, how about a feature on Compunet to go with them?

Andrew Bailey, Horsham

We get quite a number of letters and phone calls at Your Commodore asking for the POKEs for certain games so that you can be made indestructable or have infinite lives.

Our feeling is that by entering these POKEs you are spoiling the game. Surely the whole point of buying a game is to try and solve the puzzles that the programmer of the game has set? If you are going to cheat, what's the point in buying the game in the first place? Unlike many other magazines we don't publish maps of games either for exactly the same reason.

We do realise that we devote a large number of pages to listings. This is not a cheap way of filling up pages, in fact it is usually more expensive. The reason that we have so many pages of listings is quite simple. We aim to publish programs of as high a quality as possible, in fact most of our programs are of commercial quality. Obviously the better programs are usually the longer ones and this does take up space.

We could reduce the amount of space that we give over to listings by simply publishing hex loaders for all the programs. At the moment we publish both a loader and the assembly code. Many people prefer it this way since they can follow the program through and find out how it works.

As for your question about Compunet. We do have a regular article on communications called Communications Corner and we also have a number of pages and programs on Compunet.

Letter from Oz

I was reading through my back issues of Your Commodore when I came across an article in the May issue called Softrock.

What do you mean by saying: "They're not bad for Aussies". If you stopped whinging and looked around, you'd see that our country is 10 times better than yours. Also Rolf Harris is not the only musician of any note, he is hopeless. If you want good music then listen to the Models, Men at Work, Australian Crawl, INXS, Pseudo Echo, Midnight Oil and Icehouse among others.

And, all Australians don't play didgeredoos, so go stick a pork pie up your nose.

When you make some decent software, get a decent cricket team and win the America's Cup then you can start knocking other people. Tom Nash is dead meat.

And you'd better publish this letter, unless it takes as long to get to England as your magazine takes to get here, in which case you'll never get it!

Damien Marsh, Victoria, Australia (and proud of it!)

We'd like to apologise to Damien and any other Australian readers who found this offensive. Our reviewers occasionally get a bit carried away. However we'd just like to point out that England now holds the Ashes!

BUILD A BETTER BASIC

Nick Hampshire once again adds more blocks to your ever-increasing supply of Basic commands.

IN THE LAST THREE ARTICLES in this series I have given all the initialisation and wedge routines needed to add extra commands to the Basic of a C64 computer.

I have also given the code to add nine new commands to Basic. These are; CTL, APPEND, CHANGE, DUMP, FIND, AUTO, CHAIN, DELETE, and RENUMBER. This month I am adding a further three commands, they are; MAT, SORT, and VARPTR.

These commands, unlike the previous 'toolkit' type commands, are used to manipulate and modify data arrays. Data manipulation commands like these can both save considerable amounts of Basic program code, and in addition have the added bonus of a considerably shorter processing time. All three new commands require that the wedge and initialisation code given in the first part of the series are present in memory at the correct locations, and that their command names and entry points are stored in the correct tables. These commands are independent of the previously added commands and can therefore be used without the previous routines. To ensure that you have the wedges and new routines correctly positioned, the Basic loader at the end of this article gives only the initialisation routines and the three new commands. The commands added in previous issues have been left out in order to keep the loader of a manageable size. All the programs used in this series are extracted from the book *Advanced Commodore 64 Basic Revealed* by Nick Hampshire and published by Collins.

MAT

Abbreviated entry; M(shift)A
Token: Hex $EE,$11, Decimal 238,17
Modes: Program and direct
Purpose: To perform arithmetic operations on entire arrays, assuming their contents to be matrices.
Syntax: MAT array name = (arithmetic expression). Assigns scalar value to all elements of the matrix in the array. Brackets are required around the expression.
MAT array name = array name Assigns all corresponding elements from one array to another. Both arrays must be numeric and of the same dimensions.
MAT array name = array name operator (arithmetic expression).
Or MAT array name = (arithmetic expression) operator array name. The operator may be + or * to add or multiply a matrix with a scalar value.
MAT array name = array name + array name. All three arrays must be of the same dimensions, and numeric.
MAT array name = array name * array name. Array sizes must follow the convention for matrix multiplication ie. (a × c) = (a × b)*(b × c). Where a,b,c are the array sizes in the DIM statement plus 1 (element 0) is used.

```
MAT.COMMAND

1000 ;****************************
1010 ; 16 BIT UNSIGNED MULTIPLY
1020 ;****************************
1030 ; WAREA = N1 * N2
1040 ;
1050 N1 .WOR 0
1060 N2 .WOR 0
1070 RESULT .WOR 0
1080 ;
1090 MMULT LDA #0 ;ZERO RESULT
1100  STA RESULT
1110  STA RESULT+1
1120  LDA N2 ; END IF N2=0
1130  ORA N2+1
1140  BEQ MMULT2
1150 MMULT1 LDA N1 ;N1 = 0 ?
1160  ORA N1+1
1170  BNE MMULT3
1180 MMULT2 RTS
1190 MMULT3 LDA #1 ;IF BIT 0 OF N1
1200  AND N1 ;THEN ADD N2 TO RESULT
1210  BEQ MMULT4
1220  CLC ;ADD N2 TO RESULT
1230  LDA N2
1240  ADC RESULT
1250  STA RESULT
1260  LDA N2+1
1270  ADC RESULT+1
1280  STA RESULT+1
1290 MMULT4 ASL N2 ;N2 = N2 * 2
1300  ROL N2+1
1310  LSR N1+1 ;N1 = N1 / 2
1320  ROR N1
1330  JMP MMULT1
1340 ;
1350 ;
1360 ;
1370 ;**************************
1380 ; MATRIX ARITHMETIC
1390 ;**************************
1400 ;
1410 ISNALF = $B113
```

```
1420 CHRGOT = $79
1430 CHRGET = $73
1440 VNAME1 .WOR 0 ;VARIABLE NAMES
1450 VTYPE1 .BYT 0
1460 VNAME2 .WOR 0
1470 VTYPE2 .BYT 0
1480 VNAME3 .WOR 0
1490 VTYPE3 .BYT 0
1500 FACM * = *+5 ;TEMP FLOATING STORE
1510 FACT * = *+5 ;TEMP FLOATING STORE
1520 VSIZE1 .WOR 0 ;ARRAY SIZES
1530 VSIZE2 .WOR 0
1540 VSIZE3 .WOR 0
1550 OPTYPE .BYT 0 ;OPERAND TYPE
1560 VPTR1 = $FB
1570 VPTR2 = $FD
1580 VPTR3 = $9E
1590 VSTT1 .WOR 0
1600 VSTT2 .WOR 0
1610 VSTT3 .WOR 0
1620 T1 .WOR 0
1630 T2 .WOR 0
1640 ;
1650 ;
1660 ;
1670 MAT STA VNAME1 ;GET FIRST ARRAY
1680  JSR ISNALF ;NAME AND CHECK
1690  BCS CHOK ; LEGAL
1700  JMP $AF08 ; SYNTAX
1710 CHOK LDA #0
1720  STA VNAME1+1
1730  STA VNAME2+1
1740  STA VNAME3+1
1750  STA VTYPE1
1760  STA VTYPE2
1770  STA VTYPE3
1780  JSR CHRGET
1790  BCC CHOK1
1800  JSR ISNALF
1810  BCC EDVNA1 ;GO CHECK FOR % $ =
1820 CHOK1 STA VNAME1+1
1830 LNE JSR CHRGET ;SCAN PAST REST
1840  BCC LNE ;OF VAR NAME
1850  JSR ISNALF
1860  BCS LNE
1870 EDVNA1 CMP #'$ ;CHECK FOR STRING
1880  BNE NSTR1
1890 TYMISE LDX #22
1900  JMP $A437 ;TYPE MISMATCH
1910 NSTR1 CMP #'%
1920  BNE NTINT1 ;NOT INTEGER ARRAY
1930  DEC VTYPE1 ;SET TYPE FLAG TO $FF
1940  JSR CHRGET ;GET NEXT CHAR
1950 NTINT1 CMP #$B2 ; TOKEN FOR =
1960  BEQ FOEQ
1970  JMP $AF08 ;SYNTAX NOT =
1980 FOEQ JSR CHRGET
1990  CMP #'( ;CHECK FOR ( EXP. )
2000  BNE NTEXP2
2010  JSR $AEF1 ;EVAL. EXP. IN ( )
2020  LDA $0D ;CHECK NUMERIC
2030  BNE TYMISE
2040  LDX #<FACM ;FAC#1 TO FACM
2050  LDY #>FACM
2060  JSR $BBD4
2070  LDX #1 ; SET TYPE FLAG TO CONST
2080  STX VTYPE2
2090  JMP CHKOP
2100 NTEXP2 JSR ISNALF ;GET NAME
2110  BCS CHOK2 ;CHECK LEGAL
2120  JMP $AF08 ;SYNTAX
2130 CHOK2  STA VNAME2
2140  JSR CHRGET ;GET SECOND CHAR
2150  BCC CHOK2A ;NUMBER ?
2160  JSR ISNALF
2170  BCC EDVNA2 ;CHECK FOR $ %
2180 CHOK2A STA VNAME2+1
2190 LNE2 JSR CHRGET ;SCAN TO END
2200  BCC LNE2 ;OF VARIABLE NAME
2210  JSR ISNALF
2220  BCS LNE2
2230 EDVNA2 CMP #'$ ;CHECK FOR '$'
2240  BNE NSTR2
2250  LDX #22 ; TYPE MISMATCH
2260  JMP $A437
2270 NSTR2 CMP #'% ;CHECK IF INTEGER
2280  BNE CHKOP
2290  JSR CHRGET
2300  DEC VTYPE2 ;SET INTEGER FLAG
2310 CHKOP LDX #0 ;CHECK OPERAND TYPE
2320  STX OPTYPE
2330  JSR CHRGOT ;END STATEMENT ?
2340  BNE NASSIG
2350  JMP DOMAT
2360 NASSIG INC OPTYPE
2370  CMP #$AA ;CHECK FOR ADD +
2380  BEQ GETV3
2390  INC OPTYPE
2400  CMP #$AB ;CHECK FOR SUB -
2410  BEQ GETV3
2420  INC OPTYPE
2430  CMP #$AC ;CHECK FOR MULT *
2440  BEQ GETV3
2450  JMP $AF08 ;SYNTAX
2460 GETV3 JSR CHRGET
2470  CMP #'( ;CHECK FOR ( EXP )
2480  BNE NTEXP3
2490  LDA VTYPE2 ;CHECK TYPE2 FOR
2500  CMP #1 ;BEING  CONSTANT
2510  BNE BEXPOK
2520  JMP $AF08 ;SYNTAX
2530 BEXPOK JSR $AEF1 ;EVAL EXP
2540  LDA $0D
2550  BEQ NUMOK
2560  JMP TYMISE ;TYPE MISMATCH
2570 NUMOK LDX #<FACM ;FAC#1 TO FACM
2580  LDY #>FACM
2590  JSR $BBD4
2600  LDA #1 ;SET TYPE FLAG TO CONST
2610  STA VTYPE3
2620  JSR CHRGOT ;END OF STATEMENT ?
2630  BEQ DOMAT
2640 SYNTE JMP $AF08 ;SYNTAX
2650 NTEXP3 JSR ISNALF ;GET ARRAY NAME
2660  BCC SYNTE ;SYNTAX ERROR
2670  STA VNAME3
2680  JSR CHRGET
2690  BEQ DOMAT ; : OR END OF LINE
2700  BCC CHOK3
2710  JSR ISNALF
2720  BCC EDVNA3
2730 CHOK3 STA VNAME3+1
2740 LNE3 JSR CHRGET
2750  BEQ DOMAT
2760  BCC LNE3
2770  JSR ISNALF
2780  BCS LNE3
2790 EDVNA3 CMP #'$ ;IS IT A STRING
2800  BNE NSTR3
2810  LDX #22
2820  JMP $A437
2830 NSTR3 CMP #'% ;IS IT INTEGER
2840  BNE NTINT3
2850  DEC VTYPE3
2860  JSR CHRGET ;NEXT CHAR
2870  BEQ DOMAT
2880 NTINT3 JMP $AF08 ;SYNTAX
2890 DOMAT LDA VTYPE1 ;FIND ARRAY 1
2900  BEQ V1REAL
2910  LDA #128 ;SET HI BITS ARRAY NAME
2920  ORA VNAME1
2930  STA VNAME1
2940  LDA #128
2950  ORA VNAME1+1
2960  STA VNAME1+1
2970 V1REAL JSR FINDAR ;FIND ARRAY ADDR
2980  STX VSIZE1
2990  STY VSIZE1+1
3000  LDA VPTR1 ;STORE IT
3010  STA VSTT1
3020  LDA VPTR1+1
3030  STA VSTT1+1
3040  LDA VTYPE2
3050  CMP #1
3060  BEQ GAR3 ;EXPRESSION
3070  LDA VTYPE2 ;SET UP ARRAY NAME 2
3080  AND #$80 ;FOR SEARCH ROUTINE
3090  STA T1
3100  ORA VNAME2
3110  STA VNAME1
3120  LDA VNAME2+1
3130  ORA T1
3140  STA VNAME1+1
3150  JSR FINDAR ;FIND ADDRESS ARRAY 2
```

The MAT command will only accept arrays of 1 or 2 dimensions, of only numeric type and with not more than 255 elements in either dimension.

Errors: Syntax error – when the expression is not in brackets or an illegal operator is used.
Type mismatch – for string arrays
Bad subscript – for arrays of incorrect size etc.

Use: High speed matrix arithmetic is approximately eight times faster than an equivalent Basic subroutine. Using this command also saves the use of nested FOR ... NEXT loops, and thereby reduces the chances of an out of memory error due to the stack being full. As most versions of Basic on main frame computers have full matrix arithmetic this subset of the full MAT command will be useful in converting programs to run on the C64. Matrix arithmetic is often used in programs handling large amounts of numbers in linear equations.

The routine uses the simple convention that a matrix of size a × b will be stored in an array dimensioned by DIM A(a-1, b-1). This means that a routine to read a 5 × 2 matrix from data statements would be:

```
DIM A(4,1)
FOR I = 0 TO 4
FOR J = 0 TO 1
READ A(I,J)
NEXT J,I
DATA 0,4
DATA 3,5
DATA -5,3.45
DATA 1,1
DATA .4, -4
```

To print an array use a routine like:

```
FOR I = 0 TO 4
FOR J = 0 TO 1
PRINT A(I,J),
NEXT J
PRINT
NEXT I
```

The matrix multiplication is equivalent to: For matrix sizes (a × c) = (a × b) * (b × c).

```
DIM A(a-1, c-1), B(a-1, b-1), c(b-1,c-1)
MAT A = B * C
```

is the same as but faster than :

```
FOR I = 0 TO a-1
FOR J = 0 TO c-1
T = 0
FOR K = 0 TO b-1
T = T + B(J,K) * C(K,I)
NEXT K
A(J,I) = T
NEXT J
NEXT I
```

```
3160  STX VSIZE2
3170  STY VSIZE2+1
3180  LDA VPTR1
3190  STA VSTT2
3200  LDA VPTR1+1
3210  STA VSTT2+1
3220 GAR3 LDA OPTYPE ;ARRAY 3  ?
3230  BEQ DOMATA ;NO ARRAY 3
3240  LDA VTYPE3
3250  CMP #1 ;IS IT A CONSTANT
3260  BEQ DOMATA ;YES
3270  AND #$80 ; IS ARRAY 3 INTEGER
3280  STA T1
3290  LDA VNAME3
3300  ORA T1
3310  STA VNAME1
3320  LDA VNAME3+1
3330  ORA T1
3340  STA VNAME1+1
3350  JSR FINDAR ;FIND ARRAY 3
3360  STX VSIZE3
3370  STY VSIZE3+1
3380  LDA VPTR1
3390  STA VSTT3
3400  LDA VPTR1+1
3410  STA VSTT3+1
3420 DOMATA LDA OPTYPE ;SET A JUMP VECTOR
3430  ASL A ;FOR OPERATION
3440  TAX
3450  LDA OPJTAB,X
3460  STA OPJMP
3470  LDA OPJTAB+1,X
3480  STA OPJMP+1
3490  JMP (OPJMP)
3500 ;
3510 OPJMP .WOR 0 ;JUMP VECTOR
3520 OPJTAB .WOR ASSGN ;JUMP TABLE
3530  .WOR ADDSUB
3540  .WOR ADDSUB
3550  .WOR MULT
3560 ; *** MAT AA = C
3570 ASSGN LDA #1
3580  CMP VTYPE2
3590  BEQ ASSIC
3600  JMP ASARAR
3610 ASSIC LDX #5 ;ARRAY =CONSTANT
3620  LDA VTYPE1
3630  BEQ ASSR1
3640  LDA #<FACM ;FACM TO FAC#1
3650  LDY #>FACM
3660  JSR $BBA2
3670  JSR $B1BF ;FLOAT TO FIXED
3680  LDA $64 ;STORE INT IN FACM
3690  STA FACM
3700  LDA $65
3710  STA FACM+1
3720  LDX #2
3730 ASSR1 STX VTYPE2 ;STORE ELEMENT LENGTH
3740  LDA #0 ;CALC NUMBER OF ELEMENTS
3750  STA N1+1
3760  STA N2+1
3770  LDA VSIZE1
3780  STA N1
3790  LDA VSIZE1+1
3800  STA N2
3810  JSR MMULT ;RESULT =N1 * N2
3820  JSR TRPT1 ;COPY POINTER TO ZERO PAGE
3830  LDY #0
3840 ASLOOP LDX #0 ;FACM TO ARRAY
3850 ASLOP LDA FACM,X
3860  STA (VPTR1),Y
3870  INX
3880  INC VPTR1
3890  BNE ASNC
3900  INC VPTR1+1
3910 ASNC CPX VTYPE2
3920  BNE ASLOP
3930  LDA RESULT
3940  BNE ASNC9
3950  DEC RESULT+1
3960 ASNC9 DEC RESULT ;ARRAY FILLED ?
3970  LDA RESULT
3980  ORA RESULT+1
3990  BNE ASLOOP
4000  RTS
4010 ;
4020 ASARAR LDX #5 ;SET VAR LENGTH
4030  LDA VTYPE1
4040  BEQ ASR1R
4050  LDX #2
4060 ASR1R STX VTYPE1
4070  LDX #5
4080  LDA VTYPE2
4090  BEQ ASR2R
4100  LDX #2
4110 ASR2R STX VTYPE2
4120  LDA VSIZE1 ;COMPARE ARRAY SIZES
4130  CMP VSIZE2
4140  BEQ ASRSOK
4150 ASRSUB LDX #$12 ;BAD SUBSCRIPT ERROR
4160  JMP $A437
4170 ASRSOK LDA VSIZE1+1
4180  CMP VSIZE2+1
4190  BNE ASRSUB ; ERROR
4200  LDA VTYPE1 ;ARRAYS SAME TYPE ?
4210  CMP VTYPE2
4220  BNE ASRIR ;NO
4230  LDA #0 ;CALC SIZE OF ARRAYS
4240  STA N1+1
4250  STA N2+1
4260  LDA VSIZE1
4270  STA N1
4280  LDA VSIZE1+1
4290  STA N2
4300  JSR MMULT
4310  LDA RESULT
4320  STA N1
4330  LDA RESULT+1
4340  STA N1+1
4350  LDA VTYPE1
4360  STA N2
4370  LDA #0
4380  STA N2+1
```

```
4390  JSR MMULT
4400  JSR TRPT2 ;SET POINTERS TO ARRAYS
4410  LDY #0
4420 ASSTLO LDA (VPTR2),Y ;BLOCK MOVE OF
4430  STA (VPTR1),Y ;LENGTH IN RESULT
4440  INC VPTR1
4450  BNE ASSTN1
4460  INC VPTR1+1
4470 ASSTN1 INC VPTR2
4480  BNE ASSTN2
4490  INC VPTR2+1
4500 ASSTN2 LDA RESULT
4510  BNE ASSTN3
4520  DEC RESULT+1
4530 ASSTN3 DEC RESULT
4540  LDA RESULT
4550  ORA RESULT+1
4560  BNE ASSTLO
4570  RTS
4580 ASRIR LDA #0
4590  STA N1+1
4600  STA N2+1
4610  LDA VSIZE1
4620  STA N1 ;CALC NUMBER OF ELEMENTS
4630  LDA VSIZE1+1
4640  STA N2
4650  JSR MMULT
4660  JSR TRPT2
4670 ASRLOP LDY #0
4680  LDX #0 ;ARRAY ELEMENT TO FACM
4690 ASRLP1 LDA (VPTR2),Y
4700  STA FACM,X
4710  INC VPTR2
4720  BNE ASRNC2
4730  INC VPTR2+1
4740 ASRNC2 INX
4750  CPX VTYPE2
4760  BNE ASRLP1
4770  CPX #5
4780  BNE ASRITR
4790  LDA #<FACM ;FACM TO FAC#1
4800  LDY #>FACM
4810  JSR $BBA2
4820  JSR $B1BF ;FLOAT TO FIXED
4830  LDA $64
4840  STA FACM
4850  LDA $65
4860  STA FACM+1
4870  JMP ASRTM ;FACM TO ARRAY
4880 ASRITR LDA FACM
4890  LDY FACM+1
4900  JSR $B391 ;FIXED TO FLOAT
4910  LDX #<FACM ;FAC#1 TO FACM
4920  LDY #>FACM
4930  JSR $BBD4
4940 ASRTM  LDY #0
4950  LDX #0
4960 ASRTM1 LDA FACM,X
4970  STA (VPTR1),Y
4980  INX
4990  INC VPTR1
5000  BNE ASRNC1
5010  INC VPTR1+1
5020 ASRNC1 CPX VTYPE1
5030  BNE ASRTM1
5040  LDA RESULT
5050  BNE ASRTM3
5060  DEC RESULT+1
5070 ASRTM3 DEC RESULT
5080  LDA RESULT
5090  ORA RESULT+1
5100  BEQ ASREXT
5110  JMP ASRLOP
5120 ASREXT RTS
5130 ;
5140 ; FIND ARRAY
5150 FINDAR LDA $2F ;START OF ARRAYS
5160  STA VPTR1
5170  LDA $30
5180  STA VPTR1+1
5190 FALOOP LDA VPTR1 ;CMP. END OF ARRAYS
5200  CMP $31
5210  BNE FACONT
5220  LDA VPTR1+1
5230  CMP $32
5240  BNE FACONT
5250  LDX #$12 ;BAD SUBSCRIPT ERROR
5260  JSR $A437
5270 FACONT LDY #0
5280  LDA (VPTR1),Y ;FIRST CHAR OF NAME
5290  INY
5300  CMP VNAME1
5310  BNE FANAR ;TRY NEXT ARRAY
5320  LDA (VPTR1),Y
5330  CMP VNAME1+1
5340  BEQ FAGETS ; GET ARRAY DATA
5350 FANAR INY ;FIND NEXT ARRAY
5360  LDA (VPTR1),Y
5370  STA T1
5380  INY
5390  LDA (VPTR1),Y
5400  CLC
5410  ADC VPTR1+1
5420  STA VPTR1+1
5430  LDA T1
5440  CLC
5450  ADC VPTR1
5460  STA VPTR1
5470  BCC FANC
5480  INC VPTR1+1
5490 FANC JMP FALOOP
5500 FAGETS LDA #1 ;GET ARRAY DATA
5510  STA T1+1
5520  INY
5530  INY
5540  INY
5550  LDA (VPTR1),Y
5560  CMP #3
5570  BMI FANDOK
5580 FAE1 LDX #$12 ;ERROR MORE THAN 2 DI
5590  JMP $A437
5600 FANDOK TAX
5610  INY
5620  LDA (VPTR1),Y
5630  BNE FAE1 ;FIRST DIM TOO BIG
5640  INY
5650  LDA (VPTR1),Y
5660  STA T1
5670  TXA
5680  DEX
5690  BEQ FAEX ;ONE DIM ARRAY
5700  INY
5710  LDA (VPTR1),Y
5720  BNE FAE1 ;SECOND DIM TOO BIG
5730  INY
5740  LDA (VPTR1),Y
5750  STA T1+1
5760 FAEX INY
5770  TYA
5780  CLC
5790  ADC VPTR1
5800  STA VPTR1
5810  LDA VPTR1+1
5820  ADC #0
5830  STA VPTR1+1
5840  LDX T1
5850  LDY T1+1
5860  RTS
5870 ;
5880 ADDSUB JSR ORDER ;PUT CONST LAST
5890  LDA VSIZE1 ;CHECK ARRAY SIZES
5900  STA N1
5910  CMP VSIZE2
5920  BNE ADBADS
5930  LDA VSIZE1+1
5940  STA N2
5950  CMP VSIZE2+1
5960  BNE ADBADS
5970  LDA VTYPE2 ;V2 CONSTANT ?
5980  CMP #1
5990  BEQ ABSC
6000  LDA VSIZE2 ;V3 IS ARRAY
6010  CMP VSIZE3
6020  BNE ADBADS
6030  LDA VSIZE2+1
6040  CMP VSIZE3+1
6050  BEQ ABSC
6060 ADBADS LDX #$12 ;BAD SUBSCRIPT
6070  JMP $A437
6080 ABSC JSR TRPT3 ;COPY POINTER TO Z PAGE
6090  LDA #0 ;CALC NO. OF ELEMENTS
6100  STA N1+1
6110  STA N2+1
6120  JSR MMULT
```

```
6130 ABSLOP JSR V2TOT2 ;V2 TO (T2)
6140  JSR V3TOF1 ;V2 TO FAC#1
6150  LDA T2
6160  LDY T2+1
6170  LDX OPTYPE
6180  CPX #1
6190  BNE DOSUB
6200  JSR $B867 ; (A.Y) + FAC#1
6210  JMP ABFA
6220 DOSUB CPX #2
6230  BNE DOMULT
6240  JSR $B850 ;(A.Y)-FAC#1
6250  JMP ABFA
6260 DOMULT JSR $BA28 ;(A.Y) * FAC#1
6270 ABFA JSR F1TOV1 ;FAC#1 TO V1
6280  LDA RESULT ;CHECK ALL DONE
6290  BNE ABNC
6300  DEC RESULT+1
6310 ABNC DEC RESULT
6320  LDA RESULT
6330  ORA RESULT+1
6340  BNE ABSLOP
6350  RTS
6360 ;
6370 ORDER LDA VTYPE3 ;V2 CONST
6380  CMP #1
6390  BNE ADV2NC
6400  LDA VTYPE2 ;SWOT V2 & V3
6410  STA VTYPE3
6420  LDA VSIZE2
6430  STA VSIZE3
6440  LDA VSIZE2+1
6450  STA VSIZE3+1
6460  LDA VSTT2
6470  STA VSTT3
6480  LDA VSTT2+1
6490  STA VSTT3+1
6500  LDA #1
6510  STA VTYPE2
6520 ADV2NC RTS
6530 ;
6540 TRPT3 LDA VSTT3 ; COPY POINTERS TO
6550  STA VPTR3 ;ZERO PAGE
6560  LDA VSTT3+1
6570  STA VPTR3+1
6580 TRPT2 LDA VSTT2
6590  STA VPTR2
6600  LDA VSTT2+1
6610  STA VPTR2+1
6620 TRPT1  LDA VSTT1
6630  STA VPTR1
6640  LDA VSTT1+1
6650  STA VPTR1+1
6660  RTS
6670 ;
6680 V2TOT2 LDA VTYPE2 ;V2 TO FAC#2
6690  BEQ V2RA
6700  BMI V2INT
6710  LDA #<FACM ;FACM TO FAC#2
6720  LDY #>FACM
6730  STA T2
6740  STY T2+1
6750  RTS
6760 V2RA LDA VPTR2 ;V2 TO FAC#2
6770  LDY VPTR2+1
6780  STA T2
6790  STY T2+1
6800  LDA #5
6810 V2BPT CLC ;BUMP VPTR2
6820  ADC VPTR2
6830  STA VPTR2
6840  LDA VPTR2+1
6850  ADC #0
6860  STA VPTR2+1
6870  RTS
6880 V2INT LDY #0 ;FIXED TO FLOAT
6890  LDA (VPTR2),Y ;THEN FAC#1 TO FAC#2
6900  TAX
6910  INY
6920  LDA (VPTR2),Y
6930  TAY
6940  TXA
6950  JSR $B391 ;FIXED TO FLOAT
6960  LDX #<FACT ;FAC#1 TO FACT
6970  STX T2
6980  LDY #>FACT
6990  STY T2+1
7000  JSR $BBD4
7010  LDA #2
7020  BNE V2BPT ;GO BUMP VPTR2
7030 V3TOF1 LDA VTYPE3
7040  BNE V3INT
7050  LDA VPTR3 ;V3 TO FAC#1
7060  LDY VPTR3+1
7070  JSR $BBA2
7080  LDA #5
7090 V3BPT CLC ;BUMP VPTR3
7100  ADC VPTR3
7110  STA VPTR3
7120  LDA VPTR3+1
7130  ADC #0
7140  STA VPTR3+1
7150  RTS
7160 V3INT LDY #0 ;GET V3
7170  LDA (VPTR3),Y
7180  TAX
7190  INY
7200  LDA (VPTR3),Y
7210  TAY
7220  TXA
7230  JSR $B391 ;FIXED TO FLOAT
7240  LDA #2
7250  BNE V3BPT ;GO BUMP VPTR3
7260 F1TOV1 LDA VTYPE1 ;FAC#1 TO V1
7270  BNE V1INT
7280  LDX VPTR1
7290  LDY VPTR1+1
7300  JSR $BBD4
7310  LDA #5
7320 V1BPT CLC ;BUMP VPTR1
7330  ADC VPTR1
7340  STA VPTR1
7350  LDA VPTR1+1
7360  ADC #0
7370  STA VPTR1+1
7380  RTS
7390 V1INT JSR $B1BF ;FLOAT TO INT
7400  LDY #0
7410  LDA $64
7420  STA (VPTR1),Y
7430  LDA $65
7440  INY
7450  STA (VPTR1),Y
7460  LDA #2
7470  BNE V1BPT
7480 ;
7490 MULT LDA VTYPE2 ;CHECK FOR MULT.
7500  CMP #1 ;ARRAY BY CONSTANT
7510  BNE MERR
7520 GADS JMP ADDSUB
7530 MERR LDA VTYPE3
7540  CMP #1
7550  BEQ GADS
7560  LDA VSIZE1+1 ;CHECK ARRAY DIM.
7570  CMP VSIZE2+1
7580  BNE AAERR
7590  LDA VSIZE1 ;CHECK NOT SAME ARRAYS
7600  CMP VSIZE3
7610  BNE AAERR
7620  LDA VSIZE2
7630  CMP VSIZE3+1
7640  BNE AAERR
7650  LDA VSTT1
7660  CMP VSTT2
7670  BNE NSARRO
7680  LDA VSTT1+1
7690  CMP VSTT2+1
7700  BEQ AAERR
7710 NSARRO LDA VSTT1
7720  CMP VSTT3
7730  BNE AASOK
7740  LDA VSTT1+1
7750  CMP VSTT3+1
7760  BNE AASOK
7770 AAERR LDX #$12 ;BAD SUBSCRIPT ERROR
7780  JMP $A437
7790 AASOK JSR TRPT3 ;COPY POINTERS TO Z. P.
7800  LDA #0
7810  STA N1+1
7820  STA N2+1
7830  LDA #1
7840  STA ROW
7850  STA NROW
7860  STA COL
```

```
7870  LDA #5 ;CALC LENGTH OF V2 ROW
7880  LDX VTYPE2 ; - 1 ELEMENT
7890  BEQ AA2R
7900  LDA #2
7910 AA2R STA N1
7920  STA T1
7930  LDX VSIZE2+1
7940  DEX
7950  TXA
7960  STA N2
7970  JSR MMULT
7980  LDA RESULT ;STORE IT IN LLV2
7990  STA LLV2
8000  LDA RESULT+1
8010  STA LLV2+1
8020 AALOOP CLC ;MAIN LOOP
8030  LDA VSTT2 ;SET V2 COL. PTR. TO NEXT
8040  STA VPTR2
8050  ADC T1 ;COL OF V2
8060  STA V2COLP
8070  LDA VSTT2+1
8080  STA VPTR2+1
8090  ADC #0
8100  STA V2COLP+1
8110 AALOP LDA #0 ;ZERO ROW COL TOTAL
8120  STA FACM
8130  STA FACM+1
8140  STA FACM+2
8150  STA FACM+3
8160  STA FACM+4
8170 AAMRC JSR V2TOT2 ;GET V2
8180  JSR V3TOF1 ;GET V1
8190  LDA T2
8200  LDY T2+1
8210  JSR $BA28 ;(A.Y) * FAC#1
8220  LDA #<FACM
8230  LDY #>FACM
8240  JSR $B867 ;(A.Y) + FAC#1
8250  LDA ROW
8260  CMP VSIZE2
8270  BEQ ENDCOL
8280  INC ROW
8290  LDX #<FACM
8300  LDY #>FACM
8310  JSR $BBD4 ;FAC#1 TO (X.Y)
8320  LDA VPTR2 ;V2 PTR DOWN 1 ROW
8330  CLC
8340  ADC LLV2
8350  STA VPTR2
8360  LDA VPTR2+1
8370  ADC LLV2+1
8380  STA VPTR2+1
8390  JMP AAMRC ;GET NEXT 2 ELEMENTS
8400 ENDCOL JSR F1TOV1 ;FAC#1 (SUM) TO V1
8410  LDA #1 ;FIRST ROW
8420  STA ROW
8430  LDA COL
8440  CMP VSIZE2+1
8450  BEQ ENDROW
8460  LDA VSTT3 ;SET V2 PTR.TO START CURRENT
8470  STA VPTR3 ;ROW
8480  LDA VSTT3+1
8490  STA VPTR3+1
8500  INC COL
8510  CLC
8520  LDA V2COLP
8530  STA VPTR2
8540  ADC T1
8550  STA V2COLP
8560  LDA V2COLP+1
8570  STA VPTR2+1
8580  ADC #0
8590  STA V2COLP+1
8600  JMP AALOP
8610 ENDROW LDA NROW ;ALL ROWS DONE ?
8620  CMP VSIZE1
8630  BNE NEAA
8640  RTS ; ALL DONE
8650 NEAA LDA VPTR3
8660  STA VSTT3
8670  LDA VPTR3+1
8680  STA VSTT3+1
8690  INC NROW
8700  LDA #1 ;FIRST COL.
8710  STA COL
8720  JMP AALOOP ;GO NEXT ROW FIRST COL.
8730 NROW .BYT 0
8740 ROW .BYT 0
8750 COL .BYT 0
8760 LLV2 .WOR 0
8770 V2COLP .WOR 0
8780 .END
```

■

```
SOR

1000 SORT JSR $0079 ;GET 1ST CHAR NAME
1010  STA CA ;STORE IT
1020  JSR $0073 ;GET 2ND CHAR
1030  PHP
1040  ORA #$80 ;SET HIGH BIT
1050  STA CB ;STORE IT
1060  PLP ;NULL 2ND?
1070  BEQ SORT00 ;YES
1080  JSR $0073 ;CHARGET FOR NEXT COMMAND
1090  JMP SORT01
1100 SORT00 LDA #$80
1110  STA CB
1120 ;
1130 SORT01 LDA $2F ;SET POINTER
1140  STA $22 ; TO ARRAY
1150  LDA $2F+1
1160  STA $22+1
1170 ;
1180 SORT02 LDA $22 ;END OF ARRAYS?
1190  CMP $2F+2
1200  BNE SORT03 ;NO
1210  LDA $22+1
1220  CMP $2F+3
1230  BNE SORT03 ;NO
1240  LDA #$00 ;ARRAY NOT FOUND
1250  JMP SORT21
1260 ;
1270 SORT03 LDY #$00
1280  LDA ($22),Y
1290  CMP CA ;NAME CORRECT?
1300  BNE SORT04 ;NO
1310  INY
1320  LDA ($22),Y
1330  CMP CB
1340  BEQ SORT05 ;YES
1350 ;
1360 SORT04 LDY #$02 ;ADD LENGTH OF ENTRY
1370  LDA ($22),Y ; TO POINTER AND
1380  STA TEMP ; CHECK NEXT
1390  INY
1400  LDA ($22),Y
1410  STA TEMP+1
1420  CLC
1430  LDA $22
1440  ADC TEMP
1450  STA $22
1460  LDA $22+1
1470  ADC TEMP+1
1480  STA $22+1
1490  BCC SORT02 ;ALWAYS
1500 ;
1510 SORT05 LDY #$04
1520  LDA ($22),Y ;GET ARRAY DIMENSION
1530  CMP #$01
1540  BEQ SORT06 ;ONLY 1 DIMENSION
1550  LDA #$01 ;INCORRECT DIMENSION
1560  JMP SORT21
1570 ;
1580 SORT06 LDY #$05
1590  LDA ($22),Y ;GET NUMBER OF ELEMENTS
1600  STA NOOFE+1
1610  INY
1620  LDA ($22),Y
1630  STA NOOFE
1640  LDA NOOFE+1 ;ENOUGH ELEMENTS?
1650  BNE SORT07 ;YES
1660  LDA NOOFE
1670  CMP #$02
1680  BCS SORT07 ;YES
1690  LDA #$02 ;TOO FEW ELEMENTS
1700  JMP SORT21
1710 ;
1720 SORT07 LDA NOOFE ;SET COUNTDOWN
1730  STA NOOFC ; FOR NUMBER OF
1740  LDA NOOFE+1 ; MAIN SORT LOOPS
1750  STA NOOFC+1
```

▶

Routine entry point: $90AC
Routine operation: the MAT routine uses the following Basic ROM calls.

$AEF1 — Evaluate expression in brackets
$BBD4 — FAC #1 to memory (X,Y)
$BBA2 — Memory (X,Y) to FAC#1
$B1BF — Float to fixed
$B391 — Fixed to float
$B867 — Memory (A,Y) + FAC#1 to FAC#1
$B850 — Memory (A.Y) — FAC#1 to FAC #1
$BA28 — Memory (A.Y) * FAC#1 to FAC #1

The routine for assignment will, for speed, just perform a block memory move if the two arrays are both of the same type e.g. both integer. The multiply routine works in the same way as the basic version above. It calculates the address of the next element required just by adding a pre-calculated offset for speed.

Readers are advised to consult a standard mathematics textbook for details of matrix arithmetic.

SORT

Abbreviated entry: S(shift)0
Affected Basic abbreviations: None
Token: Hex $EE, $18, Decimal 238,24
Modes: Direct and program
Recommended mode: Either
Purpose: To sort a string array into alphabetically ascending order.
Syntax: SORT string array name – the string array name must be 1 or 2 bytes long, this being the characters of the name (without the $ character).
Errors: Syntax error – if no name is specified.
Array not found – if the string array specified does not exist.
Incorrect dimension – if the string array specified has more than one dimension.
Insufficient elements – if the string array has only 1 element.
Use: SORT is a bubble sort routine that will sort a string array so that all of the strings in the array can be read in alphabetically ascending order. For example:

A$()	After SORT A
0 TEST	AFTER
1 SORT	BUBBLE
2 NAME	NAME
3 BUBBLE	READ
4 AFTER	READING
5 READING	SORT
6 READ	TEST

Routine entry point: $9D25
Routine operation: The array name is first read in and stored away in the Basic's format for string arrays. The array storage area is then scanned for that array and if not found, the message array not found is displayed. If the array is found, the number of dimensions is checked and if there is more than one dimension, the message 'incorrect dimension' will be displayed. If that is OK, the dimension is checked and if it is only one value the message 'insufficient elements' is displayed. If all checks are OK the array is then sorted.

```
1760 ;
1770 SORT08 LDA #$00 ;MAIN LOOP OF SORT
1780  STA FLAGS ;RESET SWAP FLAG,
1790  STA COUNT ; AND ILOOP COUNT
1800  STA COUNT+1
1810  DEC NOOFC ;DECREASE OLOOP COUNT
1820  LDA NOOFC
1830  CMP #$FF
1840  BNE SORT09
1850  DEC NOOFC+1
1860 ;
1870 SORT09 LDA NOOFC+1 ;END OF SORT?
1880  BNE SORT10 ;NO
1890  LDA NOOFC
1900  BNE SORT10 ;NO
1910  RTS ;YES, DONE
1920 ;
1930 SORT10 CLC ;SET $24 TO $22+7
1940  LDA $22
1950  ADC #$07
1960  STA $24
1970  LDA $22+1
1980  ADC #$00
1990  STA $24+1
2000 ;
2010 SORT11 LDY #$00 ;INNER LOOP
2020  LDA ($24),Y ;GET LENGTH,ADDRESS
2030  STA LEN1 ; OF 1ST STRING
2040  INY
2050  LDA ($24),Y
2060  STA $FB
2070  INY
2080  LDA ($24),Y
2090  STA $FB+1
2100  INY
2110  LDA ($24),Y ;GET LENGTH,ADDRESS
2120  STA LEN2 ; OF 2ND STRING
2130  INY
2140  LDA ($24),Y
2150  STA $FD
2160  INY
2170  LDA ($24),Y
2180  STA $FD+1
2190  LDX LEN2 ;LEN(STR2)=0?
2200  BEQ SORT17 ;YES, DON'T SWAP
2210  LDX LEN1 ;LEN(STR1)=0?
2220  BEQ SORT16 ;YES, SWAP THEM
2230  LDY #$00
2240 SORT12 LDA ($FB),Y ;COMPARE $FB
2250  CMP ($FD),Y ; WITH $FD
2260  BEQ SORT13 ;SAME
2270  BCC SORT17 ;DIFFERENT, DON'T SWAP
2280  JMP SORT16 ;DIFFERENT, SWAP
2290 ;
2300 SORT13 INY ;LENGTH=256?
2310  BEQ SORT17 ;YES, DON'T SWAP
2320  CPY LEN1 ;END OF STR1?
2330  BCC SORT14 ;NO, CHECK STR2
2340  BEQ SORT15 ;YES
2350  BCS SORT15 ;ALWAYS
2360 ;
2370 SORT14 CPY LEN2 ;END OF STR2?
2380  BCC SORT12 ;NOT YET
2390 ;
2400 SORT15 LDA LEN1 ;LEN1=LEN2?
2410  CMP LEN2
2420  BEQ SORT17 ;YES, DON'T SWAP
2430  BCC SORT17 ;NO, LEN1<LEN2
2440 ;
2450 SORT16 LDY #$00 ;SWAP, STR1=STR2
2460  LDA LEN2 ; AND VICE VERSA
2470  STA ($24),Y
2480  INY
2490  LDA $FD
2500  STA ($24),Y
2510  INY
2520  LDA $FD+1
2530  STA ($24),Y
2540  INY
2550  LDA LEN1
2560  STA ($24),Y
2570  INY
2580  LDA $FB
2590  STA ($24),Y
2600  INY
2610  LDA $FB+1
2620  STA ($24),Y
2630  LDA #$01 ;FLAG SWAP
2640  STA FLAGS
2650 ;
2660 SORT17 INC COUNT ;INCREMENT INNER
2670  BNE SORT18 ; LOOP COUNT
2680  INC COUNT+1
2690 SORT18 LDA COUNT
2700  CMP NOOFC ;DONE?
2710  BNE SORT20 ;NO
2720  LDA COUNT+1
2730  CMP NOOFC+1
2740  BNE SORT20 ;NO
2750  LDA FLAGS ;ANY SWAPS?
2760  BEQ SORT19 ;NO, END
2770  JMP SORT08 ;DO NEXT LOOP
2780 SORT19 RTS ;ALL DONE
2790 SORT20 CLC
2800 ;
2810  LDA $24 ;INCREASE POINTER BY 3
2820  ADC #$03
2830  STA $24
2840  LDA $24+1
2850  ADC #$00
2860  STA $24+1
```

VARPTR

Abbreviated entry: V(shift)A
Affected Basic abbreviations: VAL - VAL
Token: Hex $EE,$20, Decimal 238,32
Modes: Direct and program
Recommended mode: Either
Purpose: To return the address in memory where a variable is stored.
Syntax: VARPTR (variable name) – the variable name must be in ASCII characters.
Errors: Syntax error
Use: VARPTR can be used to find the address in memory of any variable, be it simple or an element of an array. If the variable is a string, the value returned points to the length of the string (the following two bytes are the pointer to the actual string) for example: VARPTR (A$) will return the entry address of A$.

To find the address of the string: DEEK(VARPTR(A$)+1) VARPTR (BB(12)) will return the address of the twelfth element of the array BB.
Routine entry point: $9FCA
Routine operation: On entry, VARPTR scans past the opening bracket and then finds the variable (or creates it if it does not exist). The closing bracket is then scanned past and the address of the variable is converted to floating point form.

Please use our machine code entry program, to be found elsewhere in this issue, to enter this program.

```
2870  JMP SORT11 ;DO INNER LOOP
2880 ;
2890 SORT21 ASL A ;SEND ERROR MESSAGE
2900  TAY
2910  LDA POINT,Y ;ADDRESS OF MESSAGE
2920  TAX
2930  INY
2940  LDA POINT,Y
2950  TAY
2960  TXA
2970  JSR $AB1E ;SEND IT
2980  JMP $A462 ;PRINT 'IN...'
2990 ;
3000 POINT .WOR STERR1
3010  .WOR STERR2
3020  .WOR STERR3
3030 STERR1 .BYT '?ARRAY NOT FOUND',$00
3040 STERR2 .BYT '?INCORRECT DIMENSION',$00
3050 STERR3 .BYT '?INSUFFICIENT ELEMENTS',$00
3060 CA .BYT 0
3070 CB .BYT 0
3080 NOOFE .WOR 0
3090 NOOFC .WOR 0
3100 LEN1 .BYT 0
3110 LEN2 .BYT 0
3120 COUNT .WOR 0
3130 TEMP .WOR 0
3140 FLAGS .BYT 0
3150 .END
```

```
1000 VARPTR JSR $AEFA ;SCAN '('
1010  JSR $B08B ;FIND VARIABLE
1020  STA VARP01 ;STORE POINTER OFF
1030  STY VARP01+1
1040  JSR $AEF7 ;SCAN PAST ')'
1050  LDA #$00 ;SET TYPE TO REAL NUMBER
1060  STA $0D
1070  STA $0E
1080  LDX VARP01 ;GET POINTER
1090  LDA VARP01+1
1100  STX $63 ;SEND IT, STORE LOW BYTE
1110  STA $62 ;STORE HIBYTE
1120  LDX #$90 ;EXPONENT = $90
1130  SEC
1140  JMP $BC49 ;FLOAT AND SEND
1150 VARP01 .WOR 0
1160 .END
```

Because of the size of this article it was impossible to print the Basic Loader for the machine code. If you would like a copy of the loader then please send a large stamped self addressed envelope to Better Basic Loader, Your Commodore, 1 Golden Square, London W1R 3AB.

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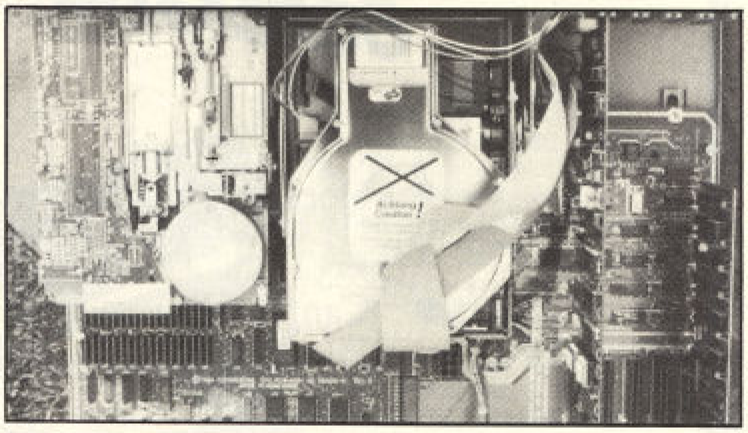
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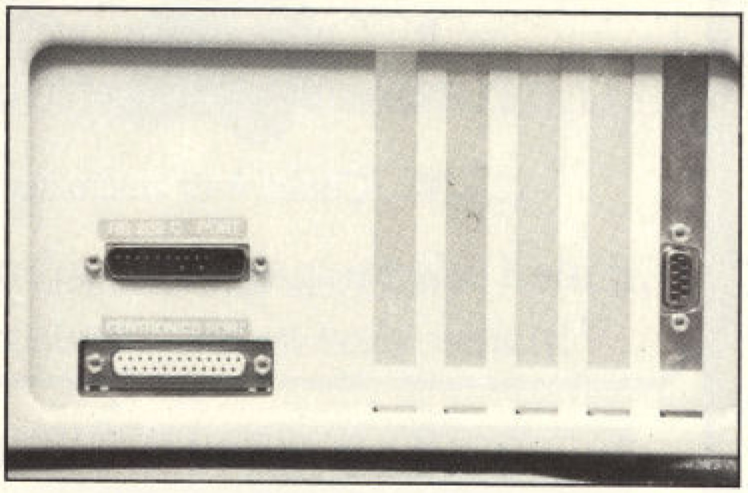
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Jayne Goin had a heart to heart with Commodore's new PC-20 and didn't suffer agonies.

PERSONAL COLUMN





FOR MOST PEOPLE IT IS HARD TO believe that it is only five short years since the home computer revolution began with the launch of Sir Clive Sinclair's ZX range of computers. Since then Commodore has become a household name but the full title of the company, Commodore Business Machines, belies its roots as a major force which changed attitudes towards computers in business and paved the way for Sinclair.

Prior to the launch of CBM's PET range of computers, business machines were unwieldy beasts and very much the preserve of the larger domestic and multinational companies. The concept of a computer on every desk was one which Commodore made very much its own.

The advantage of the PET was that it was a stand alone computer. Each machine held sufficient memory to enable an executive to perform many tasks in the comfort of the office, when previously he had to book time on the mainframe machine.

Since these halcyon days Commodore has seen many changes, including the loss of its lead to IBM's range of personal computers. IBM's domination has reached such proportions now that this company has become something of a demi-god in business circles and the PC has become a machine which has set the standard for small professional computers.

Obviously, Commodore has found the loss of the lion's share in this area a bitter pill to swallow but the launch of the PC-10 and the PC-20 heralds a new fighting attitude.

This article is partially a review of the PC-20 but because PC is a generic term it is also a review of these systems as a whole. The implication behind this is that the PC-20 complies to the standard very closely and is a worthy contender in the PC stakes.

The heart of the new machine is the 8088 microprocessor which can be considered to be the 'executive' chip. This is the decision maker and prime mover like a human executive within the business world.

In the same way that an executive increases his efficiency by having a personal assistant to perform the routine tasks of the day, the 8088 is complemented by an 8237A controller. This chip can access memory directly and can download the contents to a disk or any other peripheral leaving the main processor to carry on its main function without interruption. The result as far as the user is concerned is that a program can run continuously without having to waste time waiting for the machine to finish saving things to disk or typing data out on a printer.

To take this analogy with business organisations one stage further, the executive needs to carry out calculations during the working day. Some of these are relatively simple and can be done by mental arithmetic, but for others a calculator must be employed. Not that the executive is incapable of performing these calculations himself, it's just that he can save time this way.

In the PC, a similar situation occurs. The 8088 can only calculate with whole numbers, integers. Much of its work relies on the use of numbers with decimal places even if these are just pounds and pence. In the early days PC software had routines built in to overcome this problem and much of the software produced today is still structured this way. Greater efficiency can be achieved by giving the 8088 its own 'calculator' in the form of an 8087 chip which can perform floating point calculations.

This facility is catered for in the PC-20 and alongside the 8088 is an IC socket which can house an 8087 as an optional extra.

This multitasking organisation is the basis of the PC, an executive with a PA and a calculator, a mirror image of the real world of efficient business.

The PC-20 incorporates this basic structure in a well designed modular unit. There are many variations which can be chosen around this basic theme. Colour, graphics and sound boards can be plugged into sockets inside the main unit for specialist applications, RS232 or Centronic printers can be attached and the basic twin disk configuration can be extended to support four drives in all or even two Winchester drives.

The standard machine has two disk drives: a standard 5.25 inch 360K drive and a 10M/byte hard disk. The inclusion of the hard disk increases software security and access because the most commonly used programs can all be transferred to this disk for ready use and the saving in time and on wear and tear which normal backup copies undergo during a working day is one of the most valuable facilities which the PC-20 has to offer.

The PC is the closest thing to a 'soft' machine which can be imagined.



save money when these dire situations arise.

Obviously a resident 8K ROM must be incorporated to control initialisation of the system and the loading of the system disk but the choice of language is entirely up to the user. MS-DOS is the PC standard but the sytem disk also has an option to use GWBASIC which is one of the most user friendly Basics to date.

A full description of GW would stretch this article throughout a whole issue of Your Commodore so a mere taster is all I can give. Apart from the usual commands which form the building blocks of any Microsoft implementation of Basic, there are also the extended graphics commands which are to be found in the new 128, with the exclusion of sprites. Screen windows can be created, the memory can be structured to include machine code routines which may be called from Basic programs and related files on disk can be linked by 'pathways' to make selection easier (obviously an essential with such a lot of disk memory around).

One of the strongest facilities of the language is the SHELL command which allows the program to slip out of the current Basic program and into another program or MS-DOS routine and then back again to where it left off.

One extra facility is an integral error locator which is superb if the very strict rules of syntax are observed (spaces between commands are essential) but can give strange results if you don't. Should you, for example, omit a space between the FOR in a loop and the variable, it is quite probable that the indicator will flash under the word TO, giving rise to confusion. However, I will accept Microsoft's attitude that a PC programmer is not generally a beginner but a true professional and that such a rudimentary error would be spotted. After all there are many other errors which are not so easily noticed which this system can locate in the twinkling of an eye.

For most users Basic is not a vital facility because they are only interested in application software, but the time often comes when a specific need arises which is not covered by an existing software package and such a valuable facility as this could save money when these dire situations arise.

The technical specifications of the machine are initially modest by PC standards but this helps to keep the cost down and the unit can be expanded from a basic 256K green screen 80 × 24 text only model up to a 640K RGB colour graphics and sound systeem with a screen resolution of 720 × 350 pixels.

The keyboard is detachable, connected to the main unit by a coiled cable, and has 10 programmable function keys and a full numeric keypad. The power supply has an inbuilt fan which keeps everything relatively cool during operation, indicative of the attention of detail which Commodore has maintained despite the very modest price of £2795.

What Commodore has produced with this 16-bit PC-20, is a low-cost, efficient workstation which can draw on any of the programs in the extensive PC library. No doubt the gradual domination of IBM in the business sector has caused Commodore's executives to grind their teeth in despair but, now that they appear to have swallowed their pride and put away their PET projects, the PC-20 will give them a firm basis to build upon and maybe one day topple the usurper from the throne which was once their own.

Scratchpad

More bits and pieces to make you and your computer work better together.

HOW OFTEN DO YOU NEED to poke a two byte number into two memory locations? You know the type I mean, POKEing the start of Basic into memory locations 43 and 44. As you have no doubt found you have to split the number into two parts, its high value and low value. This is because each memory location can only hold a number up to 255.

Splitting a number into its high and low bytes is usually done with a couple of program lines such as

```
LOW = INT (NUMBER/256)
HIGH = NUMBER - INT(NUMBER/256)*256
```

This month Steve Mehew provides us with a handy little machine code routine that will automatically split a number into its two parts and POKE them into the relevant positions. You use the routine by issuing the following commands;

```
SYS 49295,A,B
```

where A is the address and B is the number. The number B is dealt with in the proper low/high order i.e. the low byte is stored in address A and the high byte is stored in address A+1.

Included in the same Basic loader is a routine that provides the C64 with an INSTRING function. The purpose of the routine is to find the first occurrence of a string within another string. The starting position of the string is then returned in another variable. To use the command you issue the following command;

```
SYS 49152,A$,B$,C
```

where A$ is the main string, B$ is the string to be searched for and C is the variable that will be left holding the starting position of the string. If B$ is not present in A$, C will be left holding zero.

As an example, if A$= "THIS IS A TEST" and B$="IS" then C would be left holding three, as three is the starting position of "IS" in the word "THIS".

Graham Orr, from Oswaldtwistle in Lancs, has sent in a handy routine that will allow you to change one type of character on the screen for another. For example you could change all of the character 'A's to 'B's. At first glance this may not seem to be all that useful but when you remember that you can redefine any of the C64's characters the routine will come into its own. You could for example define the character 'A' as a same wheel, character B could the be defined as the same wheel but rotated slightly. If you were then to swap character 'A's for 'B's and then back to 'A's you could give the impression of movement.

Now it's time for a small confession, the gremlins messed up Asmat Ullah's PRINT AT program in our November issue. The correct version should be;

```
1 FOR x=828 TO 839:READ Y:POKE X,Y:NEXT
2 DATA 32,235,183,164,20,24 32,240,255,76,157,170
```

To use this routine you simply enter;

```
SYS(828)x,y;"MESSAGE"
```

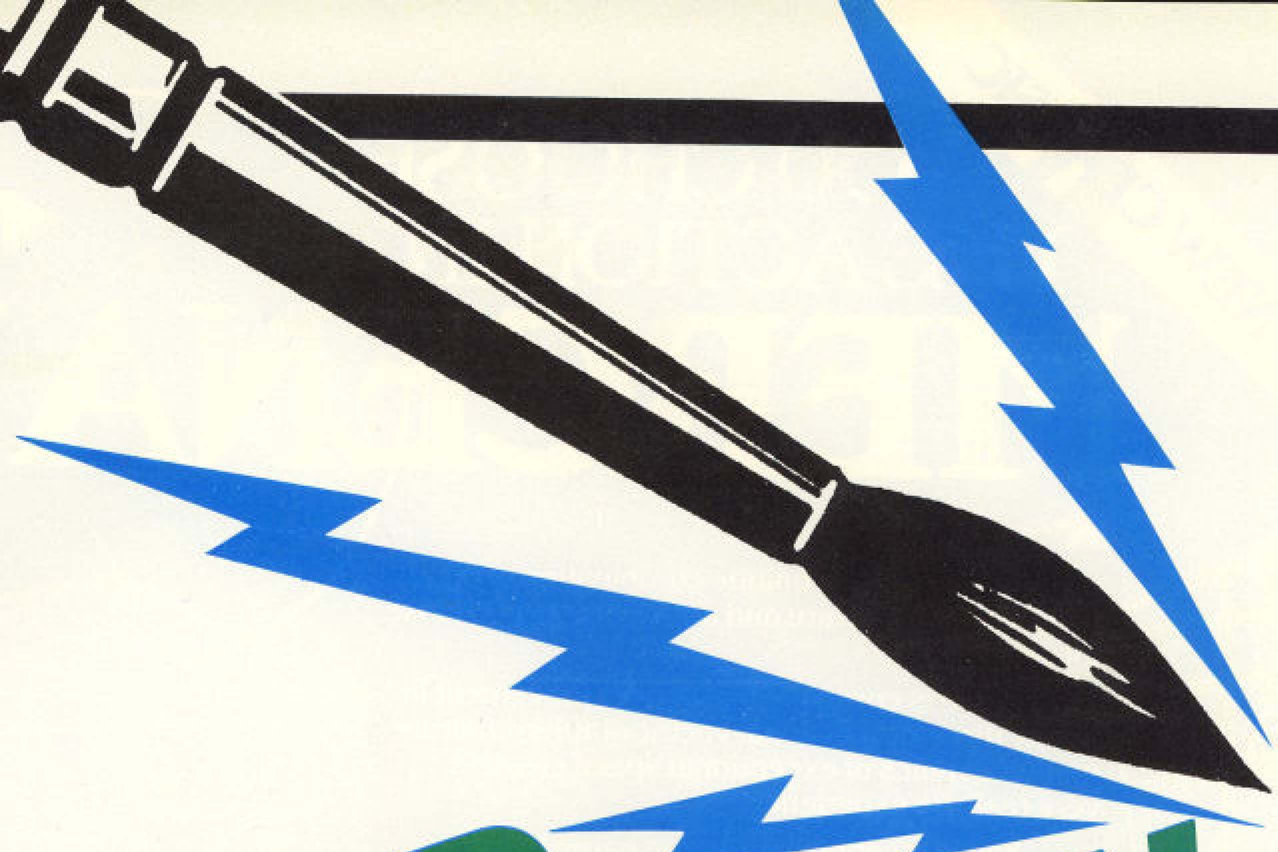
and your message will appear at the x,y position on the screen.

Well, that's it for this month. If you have any handy little routines that may be of use to other Commodore owners, why not send them to Scratchpad, Your Commodore, No 1 Golden Square, London W1R 3AB?

```
100 REM[SPC2]'INSTRING' AND
    'TWO BYTE POKE'
110 REM[SPC2]---------------
    ---------------
120 REM
130 REM COPYRIGHT STEVE MEHE
   W, MAY, 1985
140 REM --------------------
    ------------
160 S=49152:CS=0:AD=CS
170 FOR L=0 TO 22:LC=0
180 FOR D=0 TO 7:READ B
   :POKE S+AD,B
190 AD=AD+1:CS=CS+B:LC=LC+B
200 NEXT:READ B:CS=CS+B
210 IF LC<>B THEN 300
220 NEXT:IF CS<>51434 THEN 4
   00
230 PRINT:PRINT "ALL DATA
    CORRECT.":END
300 PRINT:PRINT "DATA ERROR
    IN LINE";500+L*5
310 STOP
400 PRINT:PRINT "SERIOUS DAT
   A ERROR."
410 PRINT "ERROR IN DATA AND
    LINE"
420 PRINT "CHECKSUM(S), OR
    MAIN CHECKSUM"
430 STOP
500 DATA 32,253,174,32,158,
   173,32,166,1020
505 DATA 182,133,2,168,177,
   34,153,181,1030
510 DATA 192,136,16,248,32,
   253,174,32,1083
515 DATA 158,173,32,166,182,
   133,158,165,1167
520 DATA 2,56,229,158,170,
   232,134,2,983
525 DATA 160,0,162,0,189,181,
   192,209,1093
530 DATA 34,240,7,232,228,2,
   208,244,1195
535 DATA 240,44,132,159,134,
   251,166,158,1284
540 DATA 224,1,240,18,202,
   134,252,166,1237
545 DATA 251,232,200,177,34,
   221,181,192,1488
550 DATA 208,12,198,252,208,
   243,166,251,1538
555 DATA 232,138,208,12,240,
   10,166,251,1257
560 DATA 164,159,208,207,240,
   205,169,0,1352
565 DATA 72,32,253,174,32,
   139,176,133,1011
570 DATA 73,132,74,165,13,
   208,19,165,849
575 DATA 14,208,15,104,133,
   99,169,0,742
580 DATA 133,98,162,144,32,
   68,188,76,901
585 DATA 208,187,162.22,108,
   0,3,32,722
590 DATA 253,174,32,138,173,
   32,247,183,1232
595 DATA 165,20,133,251,165,
   21,133,252,1140
600 DATA 32,253,174,32,138,
   173,32,247,1081
605 DATA 183,160,0,165,20,
   145,251,200,1124
610 DATA 165.21,145.251,96.
   255,0,255,1188
```

```
100 PRINT CHR$(147)
   :PRINT "TO USE ENTER THE
   FOLLOWING POKES"
110 PRINT:PRINT" POKE 49250,
   SCREEN CODE OF CHARACTER
   TO[SPC13]BE CHANGED"
120 PRINT:PRINT" POKE 49251,
  NEW CHARACTER"
130 PRINT:PRINT" SYS 49152
   ,TO MAKE THE CHANGE"
140 FOR T=49152 TO 49200
150 READ A
160 POKE T,A
170 NEXT
180 DATA 160,0,169,0,133,34,
   169
190 DATA 4,133,35,177,34,205,
   98
200 DATA 192,240,23,24,165,
   34,105
210 DATA 1,133,34,144,240,
   165,35
220 DATA 201,8,240,16,24,105,
   1
230 DATA 133,35,76,10,192,
   173,99
240 DATA 192,145,34,76,10,
   192,96
```


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TOP DRAW

Allen Webb brings you a High Resolution Graphics Aid to make your C64 mmore than ever like an electronic paintbrush.

IF YOU THOUGHT YOU WERE in for an easy time this month, you're wrong. I want to describe a machine code package which will provide you with 12 commands for the manipulation of bit mapped images. Whilst the commands are designed to work in high resolution mode, they will function in multicolour mode. The colour manipulation routines will not, however, work as expected.

Before you howl with anguish, this is not just another drawing package. Apart from a single command for the drawing of single points, there are no line drawing or similar commands. Before I spout forth on the package, here is a small tutorial which will explain my reason for developing the package.

In essence, there are three basic means of creating pictures on the C64.

1. You can use simple line, circle and fill commands to draw pictures. This is the approach adopted by most adventure writers and, in my opinion, doesn't give particularly detailed results.
2. You can build up pictures from redefined characters. Since, without use of raster interrupts, you are limited to 256 characters, there are limitations.
3. You can save pictures drawn by a *Koala Pad* or similar product and store them on disk.

In this article I want to describe a slightly different method of creating pictures. The idea is to set up shape tables in memory and put them on the high resolution screen in a manner similar to the potato prints used by children. Using this approach it is possible to create pictures similar to those used in games like *Lords of Midnight*.

So what is a shape table? Well it's a collection of designs saved in memory which can be copied to the high resolution screen. The system I have used is to mimic the C64's character set. This, of course, is a shape table where each entry is a character design. Each shape is a rectangle of complete eight by eight pixels. The design of each row is stored in sequence giving eight bytes. Imagine a square shape:

```
A  B  C  D
E  F  G  H
I  J  K  L
M  N  O  P
```

This is stored as:

ANCDEFGHIJKLMNOP

Any shape can be defined by its start address, width (in whole characters) and its height (in whol(haracters). If you wanted t define the above example i ı the character ROM, its start ıddress would be 53248, its width would be four and its height four. Don't try to use the character ROM directly, I have provided the means of copying the ROM to RAM so that you can play about with it.

In order to reduce the size of the code – it's long enough already – I've limited the printing of shapes to the high resolution screen to whole character positions. This isn't too much of a restriction because:

1 The colour matrix is limited to whole character positions in high resolution mode.

2 With careful design of shapes and the mixing rules provided, you can overcome this limitation.

3 If you must have single pixel positioning, you can mix sprites with the picture.

By the way, the reason I've stuck to high resolution mode is that I prefer the detail that it allows and with a bit of cunning you can get decent colour mixing.

So on with the commands. I've summarised them in Table 1 with the syntax.

Table 1

Command	Name	Syntax	Function
1	SETUP	SYS SA,I,P	initialise screen
2	COLSET	SYS SA+3,I,P	changes colours globally
3	TURNON	SYS SA+6	turn on hi-res
4	TEXT	SYS SA+9	turn on text screen
5	POINT	SYS SA+12,X,Y,F1	set point X,Y
6	CHANGECOL	SYS SA+15,I,P	change colours locally
7	AIR	SYS SA+18,BX,BY,F1,DD,BS	airbrush
8	ZONE	SYS SA+21,XS,YS,XF,YF,F1	change zone
9	CHARS	SYS SA+24,AD	set character table
10	PTOGGLE	SYS SA+27,F2	toggle paint mode
11	COPY	SYS SA+30,LN,F3,F4	print a line of text
12	SHAPE	SYS SA+33,SA,XS,YS,W1,H1,F3,F4	print a shape

In Table 1:
SA has the value 49152
X is the horizontal position of a dot
Y is the vertical position of a dot
I is the ink colour and **P** the paper colour
XS is the horizontal position of the top left corner of a shape or zone (0-319)
YS is the vertical position of the top left corner of a shape or zone (0-199)
XF is the horizontal position of the bottom right corner of a zone (0-319)
YF is the vertical position of the bottom right corner of a zone (0-399).
WI is the width of a shape (1-32)
HI is the height of a shape (0-25)
BX is the horizontal position of the top left corner of the airbrush area (0-319)
BY is the vertical position of the top left corner of the airbrush area (0-399)
BS determines the air brush size (0=small, 1=large)
DD specifies the number of dots per air brush "squirt" (0-255)
AD is the address of the character set to be down loaded: AD = 53248 for upper case, AD = 55296 for lower case
F1 determines how a dot ir drawn:
0 clears a dot
1 sets a dot
2 flips a dot
3 changes the paper in the character holding the dot but does not plot a dot. This is useful for painting a background once the foreground is finished.
F2 enables and disables the updating of paper colours when dots are drawn: 0 disables, 1 enables
F3 specifies how text and shapes are printed: 0 is overprint, 1 is Inclusive-OR, 2 is Exclusive-OR
F4 toggles text and shapes into reverse field: 0 is normal, 1 is reversed field.

Due to limitations of space, I cannot give a detailed description of the commands. I hope the following summaries will suffice.

Command 1 clears the high resolution screen to the required ink and paper values and turns it on. Command 2 changes the ink and paper values over all the screen. Commands 3 and 4 toggle between text and high-res screens without disturbing their contents.

Command 5 changes a specified point in a manner determined by flag F1. The colours will be updated if commands 6 and 10 have been used.

Command 7 draws a random area of dots with the airbrush. This is useful for shading effects. Command 8 fills, inverts or clears a rectangular area of screen. Command 10 toggles a flag which determines whether the ink and paper are updated by any drawing command. If this mode is disabled, you can update the picture without altering the colours.

Command 11 copies the top line of the text screen to the specified line on the high resolution screen. The character shapes are taken from the character area. This is the easiest way of printing text.

Command 12 puts a shape on a specified area of screen. You must specify the start address of the shape.

So you know where to save your shape tables, here is the memory map of the system:

$1000-$13E8 (1024-2023) — text screen
$A000-$BF40 (40960-48960) — high resolution bit map
$8C00-$8FE8 (35840-36840) — colour matrix
$CA00-$CE00 (51712-52736) — character table
$C000-$C5D1 (49152-50641) — machine code

This means that the safest areas for shape tables are $C5D2 to $C9FF (50642-51711) and $8FE9-$9FFF (36841-40959). This totals about SK and should be sufficient for most purposes (the demo uses only 424 bytes).

If you want to use sprites, I recommend that you use the area $8000 to $8C00. This is sufficient for 48 sprites. The sprite pointers occupy 36856 to 36863.

You should take care to protect the top of RAM and should use either of the following lines at the beginning of your program:

10 POKE 56,140: CLR
or if you use sprites:
10 POKE 56,128: CLR

Study the accompanying demonstration program, this uses many of the commands and multicolour sprites. It should give some hints on how to use the program.

For those amongst you who want to add drawing commands to the package, here are details of the dot drawing routine:

X co-ordinate MSB into $0387
X co-ordinate LSB into $0386
Y co-ordinate into $0388
F1 value into $0389
Entry point $COCS

You may find the creation of large shapes a little awkward. I use Supersoft's *Graphics Designer* for such work. Not only is it the best character/sprite designer I've used but it also allows the creation of shapes built up from up to 32 characters.

I hope you find this package worth the toil of typing it in. I believe you won't be disappointed.

High Resolution Aid

```
1 DATA76,36,192,76,178,192,76,88,192,76,146,192,76,48,193,76,132,193,76,59
2 DATA194,76,242,194,76,170,195,76,7,196,76,16,196,76,166,196,32,49,194,165
3 DATA20,141,132,3,32,49,194,165,20,141,133,3,169,160,133,169,169,0,133,168
4 DATA162,64,32,120,192,169,140,133,169,169,0,133,168,173,132,3,10,10,10,10
5 DATA13,133,3,162,8,32,120,192,173,2,221,9,3,141,2,221,173,0,221,41,252,9
6 DATA1,141,0,221,173,17,208,9,32,141,17,208,169,57,141,24,208,96,160,127
7 DATA145,168,136,16,251,72,24,165,168,105,128,133,168,169,0,101,169,133,169
8 DATA104,202,208,231,96,173,2,221,9,3,141,2,221,173,0,221,41,252,9,3,141
9 DATA0,221,173,17,208,41,223,141,17,208,169,21,141,24,208,96,32,49,194,165
10 DATA20,141,132,3,32,49,194,165,20,141,133,3,76,65,192,32,169,193,32,114
11 DATA193,32,149,193,120,165,1,41,254,133,1,88,173,134,3,41,7,141,141,3,56
12 DATA169,7,237,141,3,141,141,3,24,169,1,174,141,3,240,4,10,202,208,252,160
13 DATA0,174,137,3,240,17,224,2,240,28,17,170,145,170,120,165,1,9,1,133,1
14 DATA88,96,73,255,49,170,145,170,120,165,1,9,1,133,1,88,96,141,160,3,49
15 DATA170,141,159,3,240,6,173,160,3,76,11,193,173,160,3,76,254,192,32,49
16 DATA194,165,20,141,134,3,165,21,141,135,3,32,49,194,165,20,141,136,3,141
17 DATA143,3,32,49,194,165,20,141,137,3,32,212,194,173,137,3,201,3,240,14
18 DATA76,197,192,169,0,6,252,6,251,101,252,133,252,96,32,169,193,32,114,193
19 DATA32,149,193,96,173,143,3,74,74,74,170,32,129,195,24,169,140,101,254
20 DATA133,254,96,32,49,194,165,20,141,132,3,32,49,194,165,20,141,133,3,96
21 DATA173,232,3,240,14,173,132,3,10,10,10,10,13,133,3,160,0,145,253,96,173
22 DATA136,3,74,74,74,141,138,3,173,135,3,74,173,134,3,106,74,74,141,139,3
```

```
23 DATA141,139,3,173,136,3,41,7,141,140,3,173,138,3,133,251,169,0,133,252
24 DATA162,6,32,93,193,202,208,250,165,252,133,171,165,251,133,170,32,93,193
25 DATA32,93,193,24,165,251,101,170,133,170,165,252,101,171,133,171,169,0
26 DATA133,252,173,139,3,133,251,32,93,193,32,93,193,32,93,193,24,165,251
27 DATA101,170,133,170,165,252,101,171,133,171,24,173,140,3,101,170,133,170
28 DATA169,0,101,171,133,171,24,169,0,101,170,133,170,169,160,101,171,133
29 DATA171,96,32,253,174,32,138,173,32,247,183,96,32,49,194,165,20,141,144
30 DATA3,165,21,141,145,3,32,49,194,165,20,141,146,3,32,49,194,165,20,141
31 DATA137,3,32,49,194,165,20,141,148,3,32,49,194,165,20,141,149,3,32,187
32 DATA194,78,147,3,78,147,3,78,147,3,173,149,3,208,3,78,147,3,24,173,144
33 DATA3,109,147,3,141,134,3,173,145,3,105,0,141,135,3,32,187,194,78,147,3
34 DATA78,147,3,78,147,3,173,149,3,208,3,78,147,3,24,173,146,3,109,147,3,141
35 DATA136,3,141,143,3,32,212,194,32,197,192,206,148,3,208,174,96,169,255
36 DATA141,14,212,141,15,212,169,128,141,18,212,169,128,141,24,212,173,27
37 DATA212,141,147,3,96,173,136,3,201,200,144,5,169,200,141,136,3,173,135
38 DATA3,240,12,173,134,3,201,64,144,5,169,63,141,134,3,96,32,49,194,165,20
39 DATA164,21,141,150,3,140,151,3,32,49,194,165,20,141,152,3,32,49,194,165
40 DATA20,164,21,141,153,3,140,154,3,32,49,194,165,20,141,155,3,32,49,194
41 DATA165,20,141,137,3,173,152,3,141,158,3,238,155,3,238,153,3,173,150,3
42 DATA172,151,3,141,156,3,140,157,3,173,156,3,174,157,3,141,134,3,142,135
43 DATA3,173,158,3,141,136,3,141,143,3,32,197,192,24,173,156,3,105,1,141,156
44 DATA3,173,157,3,105,0,141,157,3,173,156,3,205,153,3,208,207,173,157,3,205
45 DATA154,3,208,199,238,158,3,173,158,3,205,155,3,208,176,96,169,0,133,253
46 DATA133,254,224,0,240,16,24,165,253,105,40,133,253,165,254,105,0,133,254
47 DATA202,208,240,24,165,253,109,139,3,133,253,165,254,105,0,133,254,96,32
48 DATA49,194,165,20,164,21,133,251,132,252,169,0,133,253,169,202,133,254
49 DATA160,0,173,14,220,41,254,141,14,220,120,165,1,41,250,133,1,177,251,145
50 DATA253,24,165,251,105,1,133,251,165,252,105,0,133,252,24,165,253,105,1
51 DATA133,253,165,254,105,0,133,254,165,253,208,222,165,254,201,206,208,216
52 DATA120,165,1,9,5,133,1,88,173,14,220,9,1,141,14,220,96,32,49,194,165,20
53 DATA141,232,3,96,32,49,194,165,20,141,169,3,32,49,194,165,20,141,160,3
54 DATA32,49,194,165,20,141,171,3,160,0,140,170,3,140,166,3,172,166,3,185
55 DATA0,4,133,163,169,0,133,164,6,163,38,164,6,163,38,164,6,163,38,164,24
56 DATA165,164,105,202,133,164,173,169,3,141,152,3,173,170,3,141,150,3,169
57 DATA1,141,153,3,141,155,3,32,225,196,238,166,3,173,166,3,201,40,240,6,238
58 DATA170,3,76,48,196,96,173,164,3,141,134,3,169,0,141,135,3,24,14,134,3
59 DATA46,135,3,14,134,3,46,135,3,14,134,3,46,135,3,173,138,3,24,10,10,10
60 DATA141,136,3,141,143,3,32,169,193,96,32,49,194,165,20,164,21,133,163,132
61 DATA164,32,49,194,165,20,141,150,3,32,49,194,165,20,141,152,3,32,49,194
62 DATA165,20,141,153,3,32,49,194,165,20,141,155,3,32,49,194,165,20,141,160
63 DATA3,32,49,194,165,20,141,171,3,32,125,197,14,153,3,14,153,3,14,153,3
64 DATA169,0,141,149,3,173,150,3,172,152,3,141,164,3,140,138,3,32,119,196
65 DATA160,0,120,165,1,41,254,133,1,88,32,70,197,120,165,1,9,1,133,1,88,200
66 DATA204,153,3,208,231,238,149,3,173,149,3,205,155,3,240,30,24,165,170,105
67 DATA64,133,170,165,171,105,1,133,171,24,165,163,109,153,3,133,163,165,164
68 DATA105,0,133,164,76,1,197,96,173,160,3,240,8,201,1,240,12,201,2,240,18
69 DATA177,163,32,109,197,76,108,197,177,163,81,170,32,109,197,76,108,197
70 DATA177,163,17,170,32,109,197,96,72,173,171,3,240,6,104,73,255,76,122,197
71 DATA104,145,170,96,173,150,3,141,156,3,173,152,3,141,158,3,169,0,141,168
72 DATA3,141,167,3,173,156,3,141,139,3,174,158,3,32,129,195,24,169,140,101
73 DATA254,133,254,32,149,193,238,156,3,238,167,3,173,167,3,205,153,3,208
74 DATA220,238,158,3,238,168,3,173,168,3,205,155,3,240,14,173,150,3,141,156
75 DATA3,169,0,141,167,3,76,145,197,96
76 REM
77 REM************************
78 REM* HIGH-RESOLUTION AID *
79 REM*       AEW 1985      *
80 REM************************
81 REM
82 FOR I=49152 TO 50641
83 READ X
84 T=T+X
85 POKE I,X
86 NEXT
87 IF T<>166584 THEN PRINT"ERROR IN DATA"
```

Garry Marshall brings you another challenge for your programming abilities. This month he deals with crossovers.

PROGRAMMING PROJECTS

The Project

FINDING OUT WHETHER lines cross over each other – and, if so, where – is a problem that crops up in several entirely different circumstances. The basic situation can be represented, regardless of application, as illustrated in Figure 1. This shows five 'places', represented by numbered circles, joined together by lines.

The lines in the figure cross over each other three times. In such a simple situation, a computer is hardly needed to count the number of crossovers and find their locations. But if there were many more places, and more lines between them, the task would be much more difficult and error-prone, and it would be a good idea to get a computer on the job.

The crossover problem is important in the design and manufacture of printed circuit boards for items of electronic equipment, from television sets to computers. Electronic components are 'printed' on a printed circuit board, and they are connected by tracks, also 'printed' on the board, that conduct electric currents between them. In Figure 1, the numbered circles correspond to the electronic components, and the lines to the tracks between them. Any tracks that cross over each other will lead to the creation of electrical paths that should not exist in the circuit. Such paths will alter the behaviour of the circuit from its required function. So, in this case, designs for printed circuit boards can be tested by seeing if they have any crossovers.

Crossovers are also of importance in the provision of water, electricity and gas supplies to houses. This time, the numbered circles in Figure 1 correspond to houses, and the lines to the paths of the water, gas and electricity pipelines. Laying the pipelines will be easier if there are no crossovers as this removes the possibility of damaging, say, the gas pipes, while dealing with the water mains.

The project is to write a program which, when given a description of a network, can display the positions of any crossovers in it.

The Solution

To write a program to find the locations of the crossovers in a network, we must first give a description of the network. This consists of the number of 'places', their locations, and the details of which ones are connected to each other. If we use the network in Figure 1, the first two items can be given directly, and the third can be given by using a rather neat method.

The number of 'places' is five, and their locations are given by their column and row positions on the screen. The pattern of connections can be recorded by giving all the pairs of positions that are connected to each other. Referring to Figure 1, we can see that one is connected to five, and three is connected to four. All the connections can be recorded in a two-dimensional array, declared by:

```
DIM C(5, 5)
```

and using its elements so that, in general, C(I, J) is assigned the number of connections between I and J. The number of connections will either be one if there is a connection, or zero if there is not. The two connections just mentioned can be recorded by:

```
C(1, 5)=1: C(3, 4)=1
```

To record that there is no connection from four to five use:

```
C(4, 5)=0
```

This gives us the first part of our program as:

```
10 DIM X(5), Y(5), C(5, 5)
20 FOR J=1 TO 5: READ X(J), Y(J): NEXT J
30 FOR J=1 TO 5: FOR K=1 TO 5
40 READ C(J, K)
50 NEXT K: NEXT J
60 DATA 50, 20, 20, 100, 120, 180, 220, 110, 190, 30
70 DATA 0, 0, 1, 1, 1, 0, 0, 1,0, 1, 1, 1, 0, 1, 1
80 DATA 1, 0, 1, 0, 0, 1, 1, 1, 0, 0
```

Given this description of the network, the program can: plot it; find the crossovers by taking every pair of lines and testing whether they cross over each other; and, for those that do cross, find the positions of the crossings and mark them. A little geometry is needed to find the equations of the lines and whether they cross, but otherwise the computation is straightforward.

After setting the high-resolution graphics mode with the subroutine starting at line 500, the network can be plotted by taking the positions of every pair of 'places' in the network and drawing a line between each connected pair, with:

```
90 GOSUB 500
110 FOR J=1 TO 4: FOR K=J+1 TO 5
120 IF C(J, K)=0 THEN 230
130 X1=X(J): X2=X(K): Y1=Y(J): Y2=Y(K)
140 GOSUB 2000
230 NEXT K: NEXT J
```

The gaps in the listing will be filled by lines for the remaining tasks. The subroutine starting at line 2000, which is called from line 140, is our standard routine that draws a line from (X1, Y1) to (X2, Y2).

Now we can test every pair of lines to see if they cross. The method for finding if a pair of lines cross is based on the idea that any point on the line from (X1, Y1) to (X2, Y2) has co-ordinates.

```
N*X1 + (1-N)*X2, N*Y1 + (1-N)*Y2)
```

Putting N=1, gives (X1, Y1) and N=0 gives (X2, Y2). Values of N between zero and one gives points in between, and other values of N give points outside, as illustrated in Figure 2. So, if we solve the equations of two lines written in this form for N, by testing the size of N we can see if the lines cross between their end-points. This gives us the following lines for finding the crossovers and counting them in CR.

```
100 CR=0
150 FOR L=1 TO 4: FOR M=L+1 TO 5
160 IF J=L AND K=M THEN 230
170 IF C(L, M)=0 THEN 230
180 X3=X(L): X4=X(M): Y3=Y(L): Y4=Y(M)
190 D=(X1-X2)*(Y4-Y3) - (Y1-Y2)*(X4-X3)
200 N=((Y4-Y3)*(X4-X2) - (X4-X3)*(Y4-Y2))/D
210 IF N  0 AND N  1 THEN CR=CR+1
220 NEXT M: NEXT L
```

Actually, each crossover is counted twice because, as the program is written, every pair

```
PROGRAM:  CROSSOVERS

 10 DIM X(5),Y(5),C(5, 5),XC(10),YC(10)
 20 FOR J=1 TO 5: READ X(J), Y(J): NEXT J
 30 FOR J=1 TO 5: FOR K=1 TO 5
 40 READ C(J, K)
 50 NEXT K: NEXT J
 60 DATA 50,20,20,100,120,180,220,110,190,30
 70 DATA 0,0,1,1,1,0,0,1,0,1,1,1,0,1,1
 80 DATA 1,0,1,0,0,1,1,1,0,1
 90 GOSUB 500
 100 CR=0
 110 FOR J=1 TO 4: FOR K=J+1 TO 5
 120 IF C(J, K)=0 THEN 230
 130 X1=X(J): X2=X(K): Y1=Y(J): Y2=Y(K)
 140 GOSUB 2000
 150 FOR L=1 TO 4: FOR M=L+1 TO 5
 160 IF J=L AND K=M THEN 220
 170 IF C(L, M)=0 THEN 220
 180 X3=X(L): X4=X(M): Y3=Y(L): Y4=Y(M)
 190 D=(X1-X2)*(Y4-Y3)-(Y1-Y2)*(X4-X3)
 200 N=((Y4-Y3)*(X4-X2)-(X4-X3)*(Y4-Y2))/D
 210 IF N>0 AND N<1 THEN CR=CR+1: XC(CR)=N*X1+(1-N)*X2: YC(
CR)=N*Y1+(1-N)*Y2
 220 NEXT M: NEXT L
 230 NEXT K: NEXT J
 240 FOR J=1 TO CR
 250 FOR R=YC(J)-3 TO YC(J)+3
 260 FOR C=XC(J)-3 TO XC(J)+3
 270 GOSUB 1000
 280 NEXT C: NEXT R: NEXT J
 290 END
 500 POKE 53272, PEEK(53272) OR 8
 510 POKE 53265, PEEK(53265) OR 32
 520 FOR I=8192 TO 16192: POKE I, 0: NEXT I
 530 FOR I=1024 TO 2023: POKE I, 22: NEXT I
 540 RETURN
 1000 RO=INT(R/8): CO=INT(C/8)
 1010 L=R AND 7
 1020 BIT=7 - (C AND 7)
 1030 BYTE=8192+RO*320+CO*8+L
 1040 POKE BYTE, PEEK(BYTE) OR 2^BIT
 1050 RETURN
 2000 DX=X2-X1: DY=Y2-Y1
 2010 IF DX=0 THEN 2070
 2020 FOR C=X1 TO X2 STEP SGN(DX)
 2030 R=INT(Y1+(C-X1)*DY/DX)
 2040 GOSUB 1000
 2050 NEXT C
 2060 RETURN
 2070 C=X1
 2080 FOR R=Y1 TO Y2 STEP SGN(DY)
 2090 GOSUB 1000
 2100 NEXT R
 2110 RETURN
```

Fig 3

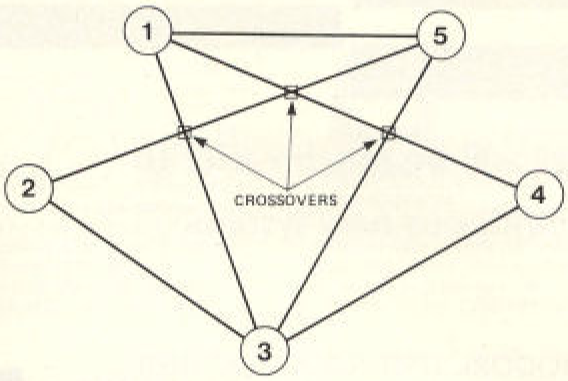


Figure 1: A network and it's crossovers

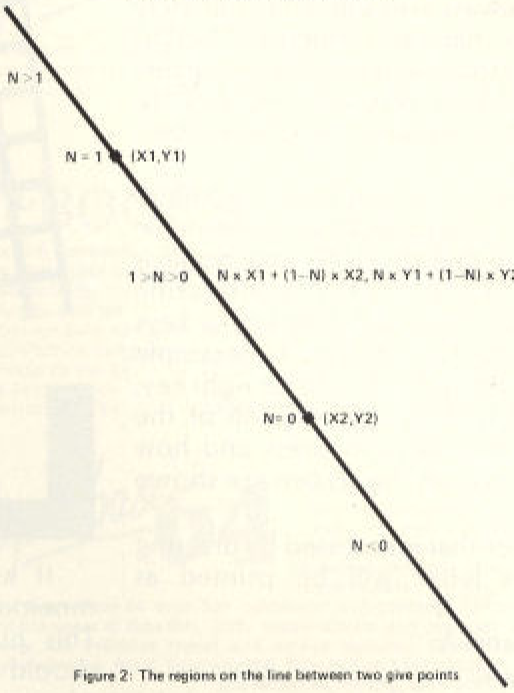


Figure 2: The regions on the line between two give points

of lines that cross is counted twice. The point where, say, line A crosses line B, is counted once when all the lines are paired with line A and a second time when all the lines are paired with line B. For this reason, the value held in CR after these lines are executed is twice the number of crossovers. We shall leave the program like this because the steps have to be taken to ensure that each crossover is counted only once complicate it considerably.

It is now a simple matter to record the position of each crossover because the value of N, which gives the position, has been found already. If we record the locations of the crossovers by placing their x- and y-co-ordinates respectively, in the elements of the arrays XC and YC, then we need only modify lines 10 and 210 as follows.

```
10 DIM X(5), Y(5), C(5, 5), XC(10), YC(10)
210 IF N  0 AND N  1 THEN CR=CR+1: XC(CR)=N*X1 + (1-N)*X2: YC(CR)=N*Y1 + (1-N)*Y2
```

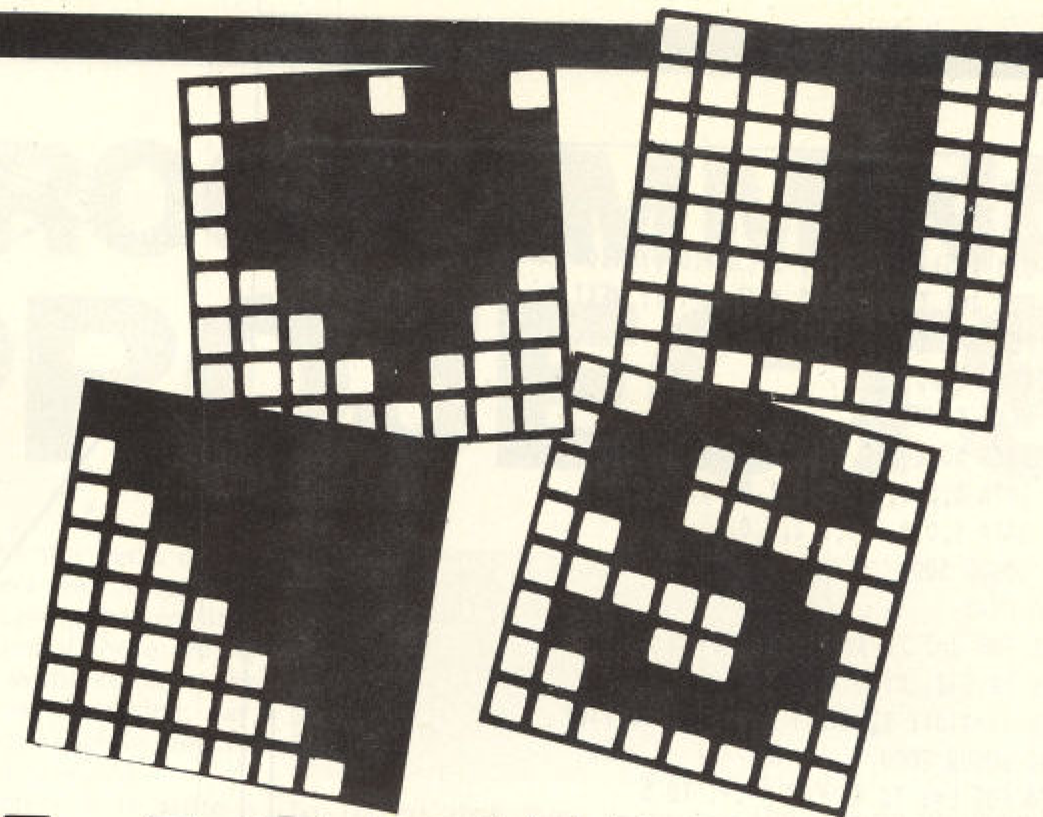
Finally, we can mark the position of each crossover with a square block composed of dots by using the subroutine, starting at line 1000, which plots a dot in column C and row R, repeatedly.

```
240 FOR J=1 TO CR
250 FOR R=YC(J)-3 TO YC(J)+3
260 FOR C=XC(J)-3 TO XC(J)+3
270 GOSUB 1000
280 NEXT C: NEXT R: NEXT J
```

The complete program listing, with the subroutines, is listed as Figure 3.

Further Developments

You can gain some confidence in the program by drawing a different network connecting five 'places', recording it in C, and seeing that the program can mark its crossovers. The program can be extended to deal with networks having more than five 'places' in them, but this is straightforward. It is somewhat more difficult to amend the program so that it does not count, and mark, every crossover twice. The crossovers can be marked more effectively, perhaps with a flashing block, like a cursor. Some way of displaying the number of crossovers would also enhance the program.



LISTINGS

Listings will be much easier to enter with our new system.

COMMODORE LISTINGS ARE RATHER well known for the horrible little black blobs that always abound. Unfortunately the graphics characters which are used to represent graphic and control characters do not reproduce very well and they are also difficult to find on the Commodore keyboard.

In future all control and graphics commands will be replaced by a mnemonic within square brackets. This mnemonic is not typed out as printed in the magazine but rather the corresponding key or keys on the keyboard are pressed. For example [RIGHT] means press the cursor right key, you do not type in [RIGHT]. All of the keywords, what keys to press and how they are shown on the screen are shown below.

Any character that is accessed by pressing shift and a letter will be printed as [Sletter].

[SA] shift and A
[S+] shift and +

Any character that is accessed by pressing the Commodore key and a letter will be printed as [Cletter]

[CA] Commodore and A
[C+] Commodore and +
[C1] Commodore and 1

If any characters are repeated the mnemonic will be followed by a number. This number is how many times you should enter the character. Any number of spaces over one will also be represented in this form

[RIGHT10] press cursor right 10 times
[C+10] press Commodore and + 10 times
[SPC10] Press the space bar 10 times

Any other characters should be easily recognisable for example CTRL-N means press CTRL and N and LEFT-ARROW means press the left arrow.

Any number of mnemonics can be enclosed in brackets for example

[SA10,SPC10,SA10]

means type 10 shift A's 10 spaces and another 10 shift A's.

Mnemonic	Symbol	what to press
[RIGHT]		left/right
[LEFT]		shift left/right
[UP]		Shift & up /down
[DOWN]		up/down
[F1]		f1
[F2]		shift & f1
[F3]		f3
[F4]		shift & f3

Mnemonic	Symbol	what to press
[F5]		f5
[F6]		shift & f5
[F7]		f7
[F8]		shift & f7
[CLEAR]		shift & CLR /HOME
[HOME]		CLR/HOME
[RVSON]		CTRL & 9
[RVSOFF]		CTRL & 0

Mnemonic	Symbol	what to press
[BLACK]		CTRL & 1
[WHITE]		CTRL & 2
[RED]		CTRL & 3
[CYAN]		CTRL & 4
[PURPLE]		CTRL & 5
[GREEN]		CTRL & 6
[BLUE]		CTRL & 7
[YELLOW]		CTRL & 8



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YC 1/86

```
400 TS$=F$:TO=PEEK(53)+256*PEEK(54)-LEN(TS$)
   :POKE 782,TO/256
410 POKE 781,TO-PEEK(782)*256:POKE 780,LEN(TS$)
420 SYS 65469
430 POKE 780,1:POKE 781,D:POKE 782,0:SYS 65466
440 POKE 254,S/256:POKE 253,S-PEEK(254)*256:POKE 780,253
450 POKE 782,(E+1)/256:POKE 781,(E+1)-PEEK(782)*256
   :SYS 65496:RETURN
460 REM **** LOAD DATA ****
470 INPUT"[CLEAR,DOWN2,RIGHT2]FILE NAME :";F$
480 IF F$="" OR LEN(Q$)>15 THEN RETURN
490 INPUT"[DOWN3,RVSON]T[RVSOFF]APE OR[SPC,RVSON]D[RVSOFF]
   ISK : D[LEFT3]";D$
500 IF D$<>"T"AND D$<>"D"THEN RETURN
510 D=1:IF D$="D"THEN D=8
520 LOAD F$,D,1:RETURN
530 PRINT:PRINT"[DOWN2,RIGHT]ERROR":ADR=ADR-12
540 POKE 54296,15:POKE 54277,10
550 POKE 54278,100:POKE 54273,45:POKE 54272,00
   :POKE 54276,17
560 FOR X=1 TO 250:NEXT
570 POKE 54276,0:POKE 54277,0:POKE 54278,0
580 RETURN
100 INPUT "[CLEAR,DOWN2]START ADDRESS ";ADR
110 PRINT "[DOWN2]PLEASE ENTER ALL DIGITS."
120 PRINT"[DOWN2]SPACES WILL BE ENTERED AUTOMATICALLY
   [DOWN2]"
130 PRINT:PRINT ADR;":";:GOSUB 260
140 IF S$="[F1]" THEN GOSUB 330:GOTO 100
150 IF S$="[F3]" THEN GOSUB 460:GOTO 100
160 REM READ DATA AND STORE
170 CHECK=ADR-INT(ADR/256)*256
180 FOR C=1 TO 36 STEP 3
190 N$=MID$(S$,C,3):N=VAL(N$)
200 CHECK=(CHECK+N)AND 255
210 IF N>255 THEN N=0
220 POKE ADR,N:ADR=ADR+1:NEXT C
230 VFY=VAL(RIGHT$(S$,3))
240 IF VFY<>CHECK THEN GOSUB 530:GOTO 130
250 GOTO 130
260 S$="":FOR C=1 TO 13:FOR L=1 TO 3
270 GET K$:IF K$=""GOTO 270
280 IF K$="[F1]" THEN C=13:L=3
290 IF K$="[F3]" THEN C=13:L=3
300 S$=S$+K$
310 PRINT K$;:NEXT L:PRINT" ";:NEXT C:RETURN
320 REM **** SAVE YOUR FILE ****
330 PRINT"[CLEAR,DOWN2,RIGHT2]SAVE FILE[DOWN2]"
340 INPUT"FILE NAME :";F$
350 IF F$="" OR LEN(F$)>15 OR F$="Q" THEN RETURN
360 INPUT"[DOWN3,RVSON]T[RVSOFF]APE OR[SPC,RVSON]D[RVSOFF]
   ISK : D[LEFT3]";D$
370 D=1:IF D$="D" THEN D=8
380 INPUT"[DOWN2]START ADDRESS IN DECIMAL :";S
390 INPUT"[DOWN]END ADDRESS IN DECIMAL[SPC4]:";E
```

EASY ENTRY EASY ENTRY

We make life easier for you with our machine code entry program.

THE WORST THING ABOUT Machine Code programming is entering thousands of numbers and then finding that the program will not work. There is nothing else that you can do apart from go through all of the listing trying to locate that mistyped character which prevents the program from working correctly.

Now there's an easier way to enter your machine code programs. With the Your Commodore machine code entry program, each line of numbers is checked as soon as you press return. If you have made a mistake you will be asked to re-type the last line. Another added bonus is that you can save what you have entered at any time to tape or disk and carry on where you left off next time you come to your computer.

Using the Loader

Before you type in any machine code program you must have typed in the machine code entry program and have it saved onto tape or disk. When you want to enter any of the machine code programs that are printed out in the form used by this program you must LOAD it into your computer. When you RUN the program you will be asked for the start address of the program. The start address is the first number in any machine code listing that appears before the colon (e.g. 49152:). You simply type in this number and press return.

All that you have to do from then on is type in all the numbers on a line. Do not type any spaces and do not type return, the program will do all of that for you. If you have made a mistake on any line the computer will ask you to type the line again. Once the line is entered correctly the computer will automatically prompt you for the next line of data.

Saving and Loading

You can save your data to tape or disk at any time by simply entering the F1 key as the first character on any line. You will then be asked for the start and end address of the save. The start address is the first number in the listing as already mentioned. The end address is the number of the last line plus 11. Don't forget to add 11 or the last line entered will not be saved.

To load back a program that you have saved you simply have to enter the F3 key as the first item on a line. You will then be asked for the name of the program.


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LIST AID

Here's a neat program that will save you money. By Bob Davis.

LIST AID OPENS UP A NEW WORLD FOR programmers. No longer are you limited to using standard paper for your listing. Instead you can list your Basic programs to any desired width (between one and 80 columns) and as a bonus, you can choose either standard or double size characters and set the print head's start position.

There are several advantages using List Aid. For a start, listing a program 60 columns wide, with the print head offset to 10 columns, gives a nice margin either side of the listing to make any notes etc. How about listing in 40 column mode, so the listing looks exactly as it would on the screen. You could use double size characters for any one with poor eyesight.

List Aid itself requires 5K of memory to operate. Therefore, the only limitation is that your program must not occupy more than 33K, when the program is initially loaded into the computer. It doesn't matter if your program requires more than 33K to run.

Using List Aid

First, type in the program exactly. You can leave the REMs out if you wish. Don't forget to SAVE it. Now run it. There are three questions to be answered.

First, the character size. It's preset for standard size. For double size press 'D' and 'return', otherwise just press 'return'. Next select the width. This is the actual column size to be listed. Enter any size between one and 80 and press 'return'. Finally the print head's TAB setting is required. This is preset for now. If all goes well, List Aid will list itself!

To list your program the following instructions must be followed exactly.

First reset the computer by switching OFF and ON, or type in SYS 64738 and 'return'. Now load the program you wish to list. Remember, your program must not occupy more than 33K. Now type in the following one line direct statement and press return. Do make sure it is exact or you will have to load all over again.

```
POKE 43,1:POKE 44,140:POKE 140*256,0:NEW
```

New? But, I just loaded it, I hear you say. Don't worry, all will be revealed later. If you've done that correctly the computer will respond with 'READY'. Now load List Aid, run it and your program will be listed. Don't forget to have your printer switched on and the paper all aligned.

To list another program you will have to switch off and start again.

So, what's the NEW all about then? Well, first you loaded your program. When a Basic program is loaded into the computer (which is just switched on), it is placed in memory from address 2049 onwards. The computer knows, or thinks it knows, where to place the program by looking at locations 43 and 44. The contents of these locations indicate where the Basic's memory 'BOTTOM' is. In this case 2049. Before loading any program in, try this in direct mode:

```
PRINT PEEK (43) + (44) * 256
```

The result will be 2049. By raising the 'BOTTOM' of memory above the area your program occupies, we can load a second program, List Aid, and run it, thereby not affecting the contents of your program. We do this by pokeing locatings 43 and 44 with values to make the computer 'think' that the Basic memory now begins at address 35841. The 'NEW' command resets all the other Basic pointers accordingly. The values poked to 43 and 44, 1 and 140, ensure that the maximum permissable RAM is available for your program, 33K. Before actually loading List Aid (after the pokes to 43 and 44) type in: PRINT FRE(0) and 'return'. You will see a return of 5119 bytes free. The POKE 140*256,0 ensures location 35840 contains a zero. The first byte of Basic ram **must** be a zero.

List Aid works progressively, following four fields.

1. Work out the current line number and the link address pointing to the next line.
2. Starting with its line number, concatenate a string variable representing that line. Detect end of line upon reaching link address.
3. Print routine. Send contents of string to printer, one character at a time, appropriately limited the print width, set TAB and Character size if required.
4. Check for 'double zero byte' indicating end of program. If not go to 1.

50-110	prints TITLE
130	checks if printer is switched on.
150-510	initialise. Set up Link Address, Keyword and Cursor Control Character strings.
560-690	get print mode, width and tab values.
710-760	set up print mode and customise 'QUOTE' character. Sending a normal 'quote' mark i.e. CHR$(34) to the printer is OK but if you follow this with any cursor control character, then funny things happen! So, why not send a 'customised' quote character. Same difference – no problems!
780	Field 1. Find current line number, link address to next line.
790-910	Field 2. Add line number to string. Peek current address. If Keyword, add appropriate Keyword string. If 'quote' mark then enter loop (lines 840-890). If detected add Cursor Control characters. Else, add standard ASCII code. Leave loop when second quote or end of line is detected. If not Keyword or quote character, add normal ASCII character. Increment peek address, if not same as link address, start again.
930-1000	Field 3. Print routine. Calls SUB 1080. Set up loop for length of program string. Print count = 0. Print string, one character at a time. If print count = print width or end of line is reached, print a carriage return. If a 'quote mark' CHR$(34) is detected, send customised 'quote' instead (sub 1050). When all characters are sent, send a carriage return.
1020	Field 4. Last line check. If the contents of (Link Address) AND (Link Address + 1) is 0 then the end of program is detected. Else goto 780.
1050-1060	Subroutine. Print customised 'quote' character. If print mode is double size characters then print two quotes. Note the quote character is different for double size.
1080-1090	Subroutine. Print 'TAB' many spaces to set the printer head.
1130-1140	End routine. Flash 'printer not on'. Close channel to printer.

Variables

PM print mode
PW print width
PT tab size
PA peek address
LA link address
NL newt link
LN line number
PC printer count
KW$ keyword
CC$ cursor control
**MD$** mid$ of (P$)
LN$ line number
Q$ quote character
P$ program string
P peek value of PA
L,M,D and D$ general-purpose

```
READY.

CHR$(27); 0

READY.
10 REM          LIST.AID
20 REM   (C) BOB DAVIS JAN'85
30 REM
40 REM  *** TITLE SCREEN ***
50 PRINTCHR$(147):POKE53281,6:PRINTCHR
$(158)
60 PRINTSPC(12)"[s U][s *][s *][s *][s
 *][s *][s *][s *][s *][s *][s *][s *]
[s *
][s *][s I]":PRINTSPC(12)"[s -]"SPC(13
)"[s -]"
70 PRINTSPC(12)"[s -]  LIST..AID  [s -
]":PRINTSPC(12)"[s -]"SPC(13)"[s -]"
80 PRINTSPC(12)"[s -]"SPC(6)"BY"SPC(5)
"[s -]":PRINTSPC(12)"[s -]"SPC(13)"[s
-]"
90 PRINTSPC(12)"[s -]  BOB DAVIS  [s -
]":PRINTSPC(12)"[s -]"SPC(13)"[s -]"
100 PRINTSPC(12)"[s -]"SPC(13)"[s -]":
PRINTSPC(12)"[s -] (C) JAN '85 [s -]"
110 PRINTSPC(12)"[s -]"SPC(13)"[s -]":
PRINTSPC(12)"[s J][s *][s *][s *][s *]
[s *
][s *][s *][s *][s *][s *][s *][s *][s
 *][s K]":PRINT:PRINT
120 REM  *** PRINTER ON ? ***
130 OPEN4,4:PRINT#4:IFSTTHEN1110
140 REM  *** INITIALISE ***
150 DIMKW$(75),CC$(160):LN$="":LN=0:LA
=2049
160 FORL=0TO75:READKW$(L):NEXT:GOTO220
170 DATA END,FOR,NEXT,DATA,INPUT#,INPU
T,DIM,READ,LET,GOTO,RUN,IF,RESTORE,GOS
UB
180 DATA RETURN,REM,STOP,ON,WAIT,LOAD,
SAVE,VERIFY,DEF,POKE,PRINT#,PRINT,CONT
190 DATA LIST,CLR,CMD,SYS,OPEN,CLOSE,G
ET,NEW,TAB(,TO,FN,SPC(,THEN,NOT,STEP,+
,-
200 DATA *,/,^,AND,OR,>,=,<,SGN,INT,AB
S,USR,FRE,POS,SQR,RND,LOG,EXP,COS,SIN,
TAN
210 DATA ATN,PEEK,LEN,STR$,VAL,ASC,CHR
$,LEFT$,RIGHT$,MID$,[255]
220 READ D,D$:IFD=999THEN540
230 REM   RVSON  RVSOFF
240 CC$(D)="[RVSON]"+D$+"[RVSOFF]":GOT
O220
250 DATA 5,"E",17,"Q",18,"R",19,"S",28
,"\",29,"]",30,"^",31,"_"
260 REM ** DATA 129,"[s A]" = SHIFT +
A **
270 DATA 129,"[s A]":REM A
280 DATA 133,"[s E]":REM E
290 DATA 134,"[s F]":REM F
300 DATA 135,"[s G]":REM G
310 DATA 136,"[s H]":REM H
320 DATA 137,"[s I]":REM I
330 DATA 138,"[s J]":REM J
340 DATA 139,"[s K]":REM K
350 DATA 140,"[s L]":REM L
360 DATA 144,"[s P]":REM P
370 DATA 145,"[s Q]":REM Q
380 DATA 146,"[s R]":REM R
390 DATA 147,"[s S]":REM S
400 DATA 148,"[s G]":REM T
410 DATA 149,"[s U]":REM U
420 DATA 150,"[s V]":REM V
430 DATA 151,"[s W]":REM W
440 DATA 152,"[s X]":REM X
450 DATA 153,"[s Y]":REM Y
460 DATA 154,"[s Z]":REM Z
470 DATA 155,"[s +]":REM +
480 DATA 156,"[c -]":REM CBM + -
490 DATA 157,"[s B]":REM B
500 DATA 158,"[255]":REM ^
510 DATA 159,"[c *]":REM CBM + *
520 DATA 999,ZZZ
530 REM HOME + 14 DOWN
540 Q$="[HOME][DOWN][DOWN][DOWN][DOWN]
[DOWN][DOWN][DOWN][DOWN][DOWN][DOWN][D
OWN]
[DOWN][DOWN][DOWN]"
550 REM  *** INPUT DETAILS ***
560 PRINTQ$" SELECT CHARACTER WIDTH :[
DOWN]"
570 REM RVSON/RVSOFF   3 X LEFT
580 INPUT" [RVSON]S[RVSOFF]TANDARD OR
[RVSON]D[RVSOFF]OUBLE WIDTH   S[LEFT][
LEFT
][LEFT]";P$
590 IFP$<>"S"ANDP$<>"D"THEN560
600 REM 3 X DOWN  7 X LEFT
610 PRINTQ$:INPUT"[DOWN][DOWN][DOWN] E
NTER PRINT WIDTH (1 TO 80)        [LEF
T][L
EFT][LEFT][LEFT][LEFT][LEFT][LEFT]";PW
620 IFPW=0ORPW>80THEN610
630 L=80-PW:IFP$="D"THENL=80-PW*2
640 IFL<1THENPT=0:GOTO690
650 REM 6 X DOWN  3 X LEFT
660 PRINTQ$"[DOWN][DOWN][DOWN][DOWN][D
OWN][DOWN] ENTER TAB SETTING (0 TO"L"[
LEFT
])";:INPUT"    0[LEFT][LEFT][LEFT]";PT
670 IFPT<0ORPT>LTHEN660
680 REM 9 X DOWN
690 PRINTQ$"[DOWN][DOWN][DOWN][DOWN][D
OWN][DOWN][DOWN][DOWN][DOWN] ** TO ABO
RT,
KEEP SPACE BAR PRESSED **"
700 REM  *** SET UP PRINT MODE ***
710 PM=15:IFP$="D"THENPM=14
720 REM  *** CUSTOMISE QUOTE CHAR ***
730 Q$=CHR$(8):FORL=1TO6:READD:Q$=Q$+C
HR$(D):NEXT:Q$=Q$+CHR$(15)
740 DATA 128,135,128,135,128,128
750 IFPM=14THENQ$=CHR$(8):FORL=1TO6:RE
ADD:Q$=Q$+CHR$(D):NEXT:Q$=Q$+CHR$(15)
760 DATA 128,135,135,128,128,128
770 REM  *** MAIN LOOP ***
780 NL=(PEEK(LA+1)*256)+PEEK(LA):LN=(P
EEK(LA+3)*256)+PEEK(LA+2):PA=LA+4
790 P$=STR$(LN)+" "
800 P=PEEK(PA)
810 IFP=255THENP$=P$+"[255]":GOTO910
820 IFP>127THENP$=P$+KW$(P-128):GOTO91
0
830 IFP<>34THEN900
840 P$=P$+CHR$(34):GOTO880
850 IFP<32THENP$=P$+CC$(P):GOTO880
860 IFP>127ANDP<160THENP$=P$+CC$(P):GO
TO880
870 P$=P$+CHR$(P)
880 PA=PA+1:P=PEEK(PA):IFPA=NLTHEN930
890 IFP<>34THEN850
900 P$=P$+CHR$(P)
910 PA=PA+1:IFPA<NLTHEN800
920 REM  *** PRINTER ROUTINE ***
930 L=LEN(P$):P$=RIGHT$(P$,L-1):L=L-2
940 PC=0:GOSUB1080:FORM=1TOL
950 MD$=MID$(P$,M,1):PC=PC+1:IFMD$=CHR
$(18)ORMD$=CHR$(146)THENPC=PC-1
960 GETK$:IFK$<>""THEN1140
970 PRINT#4,CHR$(PM);:IFMD$=CHR$(34)TH
ENGOSUB1050:GOTO990
980 PRINT#4,MD$;
990 IFPC=PWTHENPC=0:IFM<LTHENPRINT#4:G
OSUB1080
1000 NEXT:PRINT#4
1010 REM  *** LAST LINE ? ***
1020 LA=NL:IFPEEK(LA)=0ANDPEEK(LA+1)=0
THEN 1140
1030 GOTO780
1040 REM  *** PRINT QUOTE CHARS ***
1050 PRINT#4,Q$;:IFPM=14THENPRINT#4,Q$
;
1060 RETURN
1070 REM  *** PRINT HEAD TABS ***
1080 IFPT>0THENFORTB=1TOPT:PRINT#4,CHR
$(15)" ";:NEXT
1090 RETURN
1100 REM  *** END ROUTINE ***
1110 FORL=0TO4:PRINTCHR$(147):FORM=0TO
200:NEXT
1120 REM 12 X DOWN   RVSON/OFF
1130 PRINT"[DOWN][DOWN][DOWN][DOWN][DO
WN][DOWN][DOWN][DOWN][DOWN][DOWN][DOWN
][DO
WN]"SPC(8)"**** [RVSON]PRINTER NOT ON[
RVSOFF] ***":FORM=0TO400:NEXT:NEXT
1140 PRINT#4:CLOSE4:END
```

RELIABLE ROUTINES

Mike Hart breaks you gently into the hexadecimal system.

Hex-Calculator

SOONER OR LATER, OWNERS of Commodore machines start to get tired of Basic and wish to penetrate the mysterious world of machine code. A first step along this road entails getting to grips with the hexadecimal system in which the machine code is written.

The hexadecimal system is based around a unit of 16 rather than the 10 that we are familiar with in our '10s and units' system. In the hexadecimal system, the numbers zero to nine are represented by the digits 0-9 but the numbers 10-15 are represented by the letters A-F. Sixteen in the hexadecimal system is therefore one hexadecimal unit (corresponding to our 10s) followed by no other units: hence 16 decimal is 10 hex, 17 decimal is 11 hex, 34 decimal is (2 × 16 + 2) = 22 and so on. It is conventional to prefix a hex number with the $ sign as otherwise one might get confused as to whether a number such as 11 meant 11 in the decimal system or 17 in the hexadecimal system. The decimal notation is sometimes characterised by a # sign but very often by no sign at all – this means that if you see a number by itself it is nearly always a decimal number but a hex number should always be preceded by the $ sign.

Once you get used to it, the hex system is a much more convenient way to think about the innards of your machine. For example, it makes much more sense to know that the Basic ROM for the C64 is located at $A000-$BFFF and that $C000-$CFFF is available for machine-language programs than to remember decimal (in which case the relevant numbers would be 40960-49151 and 49152-53247!) Commodore machines often seem to take three steps forward but one step back. In the days of the Commodore PET, there was a machine language monitor

```
1 REM *** HEX-CALCULATOR ***
2 :
3 REM  **    MIKE HART   **
4 :
10 REM SYNTAX FOR 'HEX-CALCULATOR' IS:-
11 :
12 REM SYS(CALL),$---- ...SYS(CALL)----
13 REM CALL=700 (BY DEFAULT)
14 :
15 REM MACHINE-CODE HEX-LOADER
16 :
17 FOR J=320 TO 349:READ X:POKE J,X:NEXT
18 DATA 160,0,177,26,201,64,144,2,105,8
19 DATA 10,10,10,10,133,2,200,177,26,201
20 DATA 64,144,2,105,8,41,15,5,2,96
30 :
40 :
50 CALL=700:LOC=CALL-21:A=LOC:B=A+4
60 :
70 FOR I=0 TO 88:READ H$:SYS 320
80 POKE LOC+I,PEEK(780):NEXT
90 :
```

```
100 REM RELOCATE CHANGES
110 :
120 AH=INT(A/256):AL=A-AH*256
130 BH=INT(B/256):BL=B-BH*256
140 POKE LOC+40,AL:POKE LOC+41,AH
150 POKE LOC+45,BL:POKE LOC+46,BH
160 POKE LOC+49,AL:POKE LOC+50,AH
170 POKE LOC+53,BL:POKE LOC+54,BH
180 PRINT
190 PRINT"--HEX-CALCULATOR LOADED--":END
199 :
200 DATA 4A       LSR      :02A7 "PRINT DIGIT S/R
201 DATA 4A       LSR      :02A8 "DIVIDE BYTE BY 16
202 DATA 4A       LSR      :02A9 "AND GET INTEGER RESULT
203 DATA 4A       LSR      :02AA "BY FOUR LSR'S
204 DATA 29,0F    AND #$0F :02AB "MASK OFF OVER 15
205 DATA 18       CLC      :02AD "CLEAR FLAG
206 DATA 69,30    ADC #$30 :02AE "ADD 48 TO GET ASCII CODE
207 DATA C9,3A    CMP #$3A :02B0 "MORE THAN 9 ?
208 DATA 90,02    BCC $02B6 :02B2 "NO - SO SKIP NEXT 2 BYTE
S
209 DATA 69,06    ADC #$06 :02B4 "YES - SO ADD 7
```

```
210 DATA 4C,D2,FF JMP $FFD2 :02B6 "PRINT & RETURN
211 DATA 4C,D7,BD JMP $BDD7 :02B9 "PRINT FPAC#1 AS ASCII DI
GIT
212 DATA 20,73,00 JSR $0073 :02BC "ENTRY POINT - GET 1ST DI
GIT
213 DATA C9,24    CMP #$24  :02BF "IS IT $ ?
214 DATA F0,1B    BEQ $02DE :02C1 "YES - BRANCH (LINE 226)
215 DATA A9,24    LDA #$24  :02C3 "NO - SO PUT $ INTO .A
216 DATA 20,D2,FF JSR $FFD2 :02C5 "AND PRINT IT
217 DATA 20,8A,AD JSR $AD8A :02C8 "INPUT NUMBER
218 DATA 20,F7,B7 JSR $B7F7 :02CB "CONVERT FPAC#1 INTO 2 BY
TES IN $14/$15
219 DATA 20,A7,02 JSR $02A7 :02CE ".A HOLDS MSB SO PRINT 1S
T DIGIT
220 DATA A5,15    LDA $15   :02D1 "RETRIEVE MSB
221 DATA 20,AB,02 JSR $02AB :02D3 "PRINT 2ND DIGIT
222 DATA 98       TYA       :02D6 "RETRIEVE LSB
223 DATA 20,A7,02 JSR $02A7 :02D7 "PRINT 1ST DIGIT
224 DATA 98       TYA       :02DA "RETRIEVE LSB
225 DATA 4C,AB,02 JMP $02AB :02DB "PRINT 2ND DIGIT AND RETU
RN
226 DATA 20,F7,B8 JSR $B8F7 :02DE "ZEROISE FPAC#1
227 DATA 20,73,00 JSR $0073 :02E1 "GET HEX DIGIT
228 DATA F0,D3    BEQ $02B9 :02E4 "DONE SO PRINT NO. AND EX
IT (LINE 211)
229 DATA C9,41    CMP #$41  :02E6 "GREATER OR EQUAL TO A ?
230 DATA 90,02    BCC $02EC :02E8 "NO- SKIP 2 BYTES
231 DATA E9,08    SBC #$08  :02EA "YES- SUBTRACT 8
232 DATA E9,2F    SBC #$2F  :02EC "NO- SUBTRACT 47 (+CARRY
FLAG IF CLEAR)
233 DATA 48       PHA       :02EE "SAVE .A ON STACK
234 DATA 20,0C,BC JSR $BC0C :02EF "TRANSFER FPAC#1 TO FPAC#
2
235 DATA A0,10    LDY #$10  :02F2 "PUT VALUE OF 16
236 DATA 20,A2,B3 JSR $B3A2 :02F4 "INTO FPAC#1
237 DATA 20,2B,BA JSR $BA2B :02F7 "FPAC#1 X. FPAC#2 -RESULT
 IN FPAC#1
238 DATA 68       PLA       :02FA "RESTORE .A
239 DATA 20,7E,BD JSR $BD7E :02FB "ADD .A TO FPAC#1
240 DATA 50,E1    BVC $02E1 :02FF "LOOP ALWAYS FOR NEXT DIG
IT (LINE 227)
241 :
242 :
300 REM HEX-DECIMAL CONVERSION
310 :
320 REM INPUT "HEX=";H$
330 REM D=0:FORJ=1 TO LEN(H$)
340 REM X=ASC(MID$(H$,J))-48
350 REM D=D*16+X+(X>9)*7:NEXT:PRINT D
360 :
370 :
400 REM DECIMAL-HEX CONVERSION
410 :
420 REM INPUT"DECIMAL=";D
430 REM H$="":FORJ=1TO4:X%=D/16:X=D-X%*16
440 REM H$=CHR$(X+48-7*(X>9))+H$
450 REM D=X%:NEXT:PRINT"$";H$
```

written into the ROM which enabled one to get to grips with hex fairly easily but this facility was denied to the generation of C64 and Vic 20 owners who had to buy or get a machine-language monitor for their machines like *Supermon*.

This month, the listing shows you how you can add a hexadecimal converter to your machine so that you can very quickly and easily input a decimal number and get its hex equivalent or input a hex number and get its decimal equivalent. The whole routine is written to be as compact as possible and is designed to occupy the space from $02A7-$0277 – a total of 89 bytes which are absolutely safe and will not be corrupted by any other operations including loading in a new program on tape. In fact, the routine only just squeezes into the available space and is a result of my passion for nice tight and compact routines that just fit into the few spare safe locations.

The listing actually contains two machine language programs and requires a little explanation so that you can follow what is going on!

Lines 17-20 contain the decimal value for a short (i.e. 30 byte) hex-loading routine which greatly speeds up the process of converting hex values to decimal within the context of a Basic program such as this. As you can see, the main body of the program is contained in DATA statements from lines 200-240 and each line of DATA has one to three hexadecimal numbers followed by a 6502 mnemonic or op-code, an addressd and finally a comment. This is to enable the experienced machine code programmers amongst you to understand the construction process – I find that I always learn a lot from studying how other people have constructed their programs. These hex values are read into a variable H$ in line 70 and then the first hex-loading routine is called at location 320. This is actually the bottom part of the stack and should be fairly safe unless you have mathematical routines with lots of brackets and/or many indented loops, all of which require a lot of stack space. The hex-loading routine, read in lines 17-20, leaves the single byte decimal value that we require in the Accumulator. To access it, we merely PEEK(780) which the designers of the Vic and the C64 thoughtfully put in to enable us to access the 6502 registers directly. Line 80 obviously POKEs the converted hex value into the value of LOC+I where LOC is decided by you, the user.

So here, you actually have two decimal-hex converts within a single program. The main converter is designed to sit in a safe location where SYS(700),$---- or SYS(700),---- will do the conversion job for you. If you precede your number by the $ sign then the converter will assume a hex number and will convert accordingly. This hex number can be of any (reasonable) length e.g. one to four digits. If you do not precede your number by a $ sign, then the converter will assume that you are inputting a decimal number and will convert it to hex for you.

The initial hex-loader which is located in the stack is purely a refinement but processes numbers at four times the speed of the Basic equivalents. If you are still wedded to Basic then lines 300-450 show how to use fairly standard conversion routines. All routines, whether Basic or machine code have to cope with the fact that the ASCII values for A-F do not immediately follow the ASCII values for the digits 0-9 but are some eight locations later. Hence the necessity to engage in a process which works out whether the values A-F are involved in any part of the conversion process and then to make whatever additional adjustments are necessary.

Changes for Vic 20

Line	C64	VIC 20
211	BD	DD
217	AD	CD
218	B7	D7
226	B8	D8
234	BC	DC
236	B3	D3
237	BA	DA
239	BD	DD

Substitute the relevant value for the VIC 20 in place of the C64 value in the specified line.

MACH

Steve Carrie concludes his machine code development system series with the assembler.

The Assembler

Now we come to the third and final program of the series, the Assembler. This is a two pass assembler which will accept source code from either the Macro Processor or direct from the Editor (assuming no MACRO definitions or calls are present) and will produce an executable machine code file. This means that all you will have to do to run your program will be to LOAD it by name and call it with a basic SYS command. For example:

LOAD "filename",8,1
SYS (start address)

During assembly, a listing is generated giving the object code and a list of symbols and their values. This may be sent to a printer by executing the TTY command before calling the Assembler.

Entering the Code

There are five Basic listings given here. As before, type them all in and save them before running. To save the code, use either the Monitor S command giving ASSEMBLER, 9000 and 9E00 as the parameters, or use:

POKE43,0:POKE44,144:POKE 45,0:POKE46,158:SAVE" ASSEMBLER",8,1
POKE43,1:POKE44,8:NEW

To call the Assembler from the Monitor, you should use either:

ASSEMBLER or
ASSEMBLER (source file) (object file)

If you use the first option, the Assembler will prompt you with ENTER FILENAME(s). You should then enter the names of the files in the same format as the second option above.

Assembler Instructions

There now follows a list of PSEUDO INSTRUCTIONS that are entered in field three.

Instruction	Function
ORG	Sets code origin in memory. This can be any memory address since the object code is written to disk and on into memory. This should be the first instruction in a program. Other assemblers may use the symbol "*"
EQU	Sets value of a symbol infield 2 to an expression in field 4. In other assemblers the equivalent symbol may simply be "="
END	Indicates end of a source code program. MACRO definitions may follow.
TXT	Puts a text string in ASCII into memory.
BYT	Puts single byte value(s) into memory.
WRD	Puts 2-byte number(s) into memory in 6502 lo-byte, hi-byte order.
DBY	Same as WRD but in reverse order.
MAC	The opening MACRO definition delimiter.
MND	The closing MACRO definition delimiter.
EXT	For future use. Actually defines a GLOBAL symbol for use with a future LINKER program.

Assembler Operand Conventions

Field 4 operands have several symbols associated with them. Some may be familiar, but others may not.

< and >: These may be used to specify which byte of a two-byte number is to be loaded into an 8-bit register. For example:

```
LOOP1 LDA #<LABEL
      LDY #>LABEL
```

loads the A-register with the low-byte of the 16 bit value LABEL, while the Y-register is loaded with the high-byte.

The apostrophe is used to signify that an ASCII character is to be used as an operand e.g.

```
LOOP2 LDA #'A
```

loads the A-register with 41 HEX, the ASCII code for A.

%: The percent symbol signifies that a binary number follows. For example:

```
LOOP3 LDX #%00000001
```

loads the X-register with 1.

$: The dollar signifies that a hexadecimal number follows. For example:

```
LOOP7 LDA # $30
LOOP8 LDX $30
```

If no symbol is used as a prefix then the number is assumed to be decimal and will be treated as such. Note that the "#" in the above examples is the standard 6502 notation for an immediate number.

When symbols are being used in field four, it is possible to add or subtract an offset using the – and + symbols. For example:

```
VICII   EQU  $D000
BORDER  EQU  VICII+$20
SCREEN  EQU  VICII+$21
        LDA  VICII+1
        STA  VICII+2
        ASL  VICII-1
        etc.....
```

This completes the description of the assembler symbols and instruction. Next, we will assemble our MACOUT program which was generated with the Macro Processor.

Assembling the Example Program

With all three utility programs on your working disk, and the three example programs MACTEST, MACLIB and MACOUT on the same disk, you are ready to assemble.

Enter the monitor and type:

ASSEMBLER MACOUT
MACOBJ

The disk drive will begin working. After a few moments, the message:

COMMODORE 64 UTILITY SERIES
ASSEMBLER V1.0
(C) 1985 S.D.C.

will appear. If all goes well, the machine will generate a listing on the screen (or printer if you used TTY). After this, the machine will re-enter the Monitor. You now have a disk file called MACOBJ.

Exit the Monitor using the X command and type:

NEW
LOAD"MACOBJ",8,1
SYS 49152

The program should act as described below:

1 Clear the screen.
2 Output a "your-name" prompt.
3 Wait for keyboard input.
4 Print what was input.
5 Exit to Basic.

Assembler Error Messages

If an error is found, the appropriate message is printed with a line number and the assembly is aborted. If an object file has

3-MACH 3

been created, it will be scratched.

Message	Meaning
REDEFINED SYMBOL	a symbol appears in field 2 twice
TOO MANY SYMBOLS	symbol workspace full
UNDEFINED SYMBOL	a symbol does not appear in field 2 having been found in field 4
BRANCH RANGE	relative branch was too big
SYMBOL SYNTAX	symbols only contain alphanumeric characters with the first character being alpha only
DIRECTIVE	a problem with a pseudo instruction
OPERAND OUT OF BOUNDS	a particular operand was too big for a particular addressing mode
OPERAND SYNTAX	bad field 4 syntax
ADDRESSING MODE	illegal addressing mode for a particular instruction
NOT AN INSTRUCTION	illegal field 3 string
FILE NOT FOUND	source file cannot be located on the current disk
SYMBOL TOO LONG	symbols are up to 9 characters long
MACRO DEFINITION	source contains MACRO symbols such as MAC and MND. Run the file on the Macro Processor first
MISSING OPERAND	missing field 4 entry
FILE OPERATION	problem with the disk files such as a write-protect being ON

Next, I will give a programming example for you to try out using this series of programs. Enter it using the Editor, call the Macro Processor and Assembler to work on it and try the program out. It will have a start address of $C000 or 49152 decimal. Simply use a Basic SYS 49152.

A Programming Example for the Utility Program Series

There now follows a programming example designed to show how you can use MACROs in programs. Delete the previous program MACTEST, MACLIB, MACOUT and MACOBJ (unless you want to keep them) using the Monitor SCRATCH command.

First, type in the following MACRO library file which contains two different MACROs. Call it MACLIB or something similar. This will be the name you use for the (macrolibraryfile) in the Macro Processor call. There is a field guide to help you.

FIELD1	FIELD2	FIELD3	FIELD4
10		MAC	
20	L	LOADSUB	NAME,LEN,LFN,DEV, SEC
30	L	LDA	# LFN
40		LDX	# DEV
5		LDY	# SEC
60		JSR	$FFBA
70		LDA	# LEN
80		LDX	#< FIL.SER
90		LDY	# > FIL.SER
100		JSR	$FFBD
110		LDA	#0
120		JMP	$FFD5
130	FIL.SER	TXT	NAME
140		MND	
150		MAC	
160	L	DOLOAD	NAME,LEN,LFN,DEV, SEC
170	L	LDA	#< MES.SER
180		LDY	# > MES.SER
190		JSR	$AB1E
200		JMP	LOADSUB1
210	MES.SER	TXT	LOADING
220		BYT	0
230	LOADSUB1	LOADSUB	NAME,LEN,LFN,DEV, SEC
240		MND	

The first MACRO LOAD SUB generates a subroutine which uses KERNAL ROM routines to perform a LOADing operation via logical file number LFN, device DEV with secondary address SEC. The file has a name NAME of length LEN. On return, a set carry flag indicates an error condition. The X and Y registers hold the highest address loaded to by the LOAD routine $FFDS.

The second MACRO DOLOAD uses the MACRO LOADSUB as a subroutine. This is really not much different to LOADSUB on its own but is included here to show how MACRO calls can be nested.

Having saved the MACRO library file to disk, re-enter the Monitor and type in the following program. Call this one anything you want.

file names in the command. If you want to list your file to the printer, give the command TTY before calling the Assembler.

FIELD1	FIELD2	FIELD3	FIELD4
10		ORG	$C000
20	BORDER	EQU	$D020
30		LDA	#15
40		STA	BORDER
45		HELLO	
50	LOADIT	JSR	GETFILE
60		BCS	ERROR
70		RTS	
80	ERROR	LDA	#<ERRMESS
90		LDY	#>ERRMESS
100		JSR	$AB1E
110		RTS	
120	ERRMESS	TXT	LOAD-ERROR
130		BYT	0
140	GETFILE	DOLOAD	MACRO,5,1,8,255
150		END	
160		MAC	
170		HELLO	
180		LDA	#$93
190		JSR	$FFD2
200		LDA	#'H
210		JSR	$FFD2
220		LDA	#'I
230		JSR	$FFD2
240		LDA	#13
250		JSR	$FFD2
260		MND	

This program shows how MACRO definitions are tagged onto the end of source code programs. The MACRO HELLO is called in line 45 and generates code to clear the screen and print "HI". The program then goes on to load the file on disk called MACRO and reports an error if it is not found. Once again, the MACRO DOLOAD generates a subroutine, while HELLO generates in-line code.

Processing the Program

Now call the Macro Processor with the following command:

MACRO (yoursourcefile) (youroutputfile) (yourlibraryfile)

substituting the names of your files for the different parameters. Assuming the files have been successfully processed, run the assembler with the command:

ASSEMBLER (youroutputfile) (yourobjectfile)

once again substituting your

If you get an error during Macro Processing or during Assembly, check it against the error tables. The errors given by the Assembler are pretty reliable as are the Macro Processor errors. The only problem may occur during Macro Processing because of the fact that more than one source file is being used and the line-numbers don't often correspond. However, if the error occurs in the source file (not the macro library file) then the number given in the error message should be accurate.

I hope that you will find these programs useful to have and that they help any of you who are just starting out in machine code programming on the Commodore 64. The three programs took about four weeks to write (and about two weeks to debug!) and I am pretty sure that they are, for the most part, error free. I am starting work on another version of the utility series which will allow both tape and multiple disk operation. If you encounter any bugs in the program, don't hesitate to

Assembler 1

```
10 DATA 76,57,156,147,13,67,79,77,77,79,68,79,82,69,32,54
20 DATA 52,32,85,84,73,76,73,84,89,32,83,69,82,73,69,83
30 DATA 13,65,83,83,69,77,66,76,69,82,32,86,49,46,48,13
40 DATA 40,67,41,32,49,57,56,53,32,83,46,68,46,67,46,13
50 DATA 13,0,69,78,84,69,82,32,70,73,76,69,78,65,77,69
60 DATA 32,0,13,65,83,83,69,77,66,76,69,82,32,69,82,82
70 DATA 79,82,32,76,79,71,13,0,13,10,13,10,84,65,66,76
80 DATA 69,32,79,70,32,83,89,77,66,79,76,83,32,85,83,69
90 DATA 68,13,10,13,10,0,13,10,65,83,83,69,77,66,76,89
100 DATA 32,76,73,83,84,73,78,71,13,10,13,10,0,32,69,82
110 DATA 82,79,82,46,0,82,69,68,69,70,73,78,69,68,32,83
120 DATA 89,77,66,79,76,0,84,79,79,32,77,65,78,89,32,83
130 DATA 89,77,66,79,76,83,0,85,78,68,69,70,73,78,69,68
140 DATA 32,83,89,77,66,79,76,0,66,82,65,78,67,72,32,82
150 DATA 65,78,71,69,0,83,89,77,66,79,76,32,83,89,78,84
160 DATA 65,88,0,68,73,82,69,67,84,73,86,69,0,79,80,69
170 DATA 82,65,78,68,32,79,85,84,32,79,70,32,66,79,85,78
180 DATA 68,83,0,79,80,69,82,65,78,68,32,83,89,78,84,65
190 DATA 88,0,65,68,68,82,69,83,83,73,78,71,32,77,79,68
200 DATA 69,0,78,79,84,32,65,78,32,73,78,83,84,82,85,67
210 DATA 84,73,79,78,0,70,73,76,69,32,78,79,84,32,70,79
220 DATA 85,78,68,0,83,89,77,66,79,76,32,84,79,79,32,76
230 DATA 79,78,71,0,77,65,67,82,79,32,68,69,70,73,78,73
240 DATA 84,73,79,78,0,77,73,83,83,73,78,71,32,79,80,69
250 DATA 82,65,78,68,0,70,73,76,69,32,79,80,69,82,65,84
260 DATA 73,79,78,0,0,0,165,144,182,144,199,144,216,144,229
,144
270 DATA 243,144,253,144,19,145,34,145,50,145,69,145,84,145
,100,145
280 DATA 117,145,133,145,255,105,101,117,255,109,125,121,97
,113,255,255
290 DATA 41,37,53,255,45,61,57,33,49,255,10,255,6,22,255,14
300 DATA 30,255,255,255,255,255,255,36,255,255,44,255,255,2
55,255,255
310 DATA 255,201,197,213,255,205,221,217,193,209,255,255,22
4,228,255,255
320 DATA 236,255,255,255,255,255,255,192,196,255,255,204,25
5,255,255,255
330 DATA 255,255,255,198,214,255,206,222,255,255,255,255,25
5,73,69,85
340 DATA 255,77,93,89,65,81,255,255,255,230,246,255,238,254
,255,255
350 DATA 255,255,255,255,255,255,255,76,255,255,255,255,108
,255,255,255
360 DATA 255,255,32,255,255,255,255,255,255,169,165,181,255
,173,189,185
370 DATA 161,177,255,255,162,166,255,182,174,255,190,255,25
5,255,255,160
380 DATA 164,180,255,172,188,255,255,255,255,74,255,70,86,2
55,78,94
390 DATA 255,255,255,255,255,9,5,21,255,13,29,25,1,17,255,4
2
400 DATA 255,38,54,255,46,62,255,255,255,255,106,255,102,11
8,255,110
```

write into the magazine about it. I'll try to reply as quickly as possible with, I hope, an answer or solution to the problem. ■

```
410 DATA 126,255,255,255,255,255,233,229,245,255,237,253,24
9,225,241,255
420 DATA 255,255,133,149,255,141,157,153,129,145,255,255,25
5,134,255,150
430 DATA 142,255,255,255,255,255,255,255,132,148,255,140,25
5,255,255,255
440 DATA 66,67,67,66,67,83,66,69,81,66,77,73,66,78,69,66
450 DATA 80,76,66,86,67,66,86,83,67,76,67,67,76,68,67,76
460 DATA 73,67,76,86,68,69,88,68,69,89,73,78,88,73,78,89
470 DATA 80,72,65,80,72,80,80,76,65,80,76,80,82,84,73,82
480 DATA 84,83,83,69,67,83,69,68,83,69,73,84,65,88,84,65
1000 FORS=36864 TO 37631
1010 READ A:POKES,A
1020 NEXT
1030 PRINT"FINISHED 1"
```

Assembler 2

```
10 DATA 89,84,83,88,84,88,65,84,88,83,84,89,65,78,79,80
20 DATA 66,82,75,65,68,67,65,78,68,65,83,76,66,73,84,67
30 DATA 77,80,67,80,88,67,80,89,68,69,67,69,79,82,73,78
40 DATA 67,74,77,80,74,83,82,76,68,65,76,68,88,76,68,89
50 DATA 76,83,82,79,82,65,82,79,76,82,79,82,83,66,67,83
60 DATA 84,65,83,84,88,83,84,89,66,89,84,84,88,84,87,82
70 DATA 68,68,66,89,79,82,71,69,81,85,69,78,68,69,88,84
80 DATA 77,65,67,77,78,68,68,69,70,144,176,240,48,208,16,80
90 DATA 112,24,216,88,184,202,136,232,200,72,8,104,40,64,96
,56
100 DATA 248,120,170,168,186,138,154,152,234,0,0,11,22,33,4
4,55
110 DATA 66,77,88,99,110,121,132,143,154,165,176,187,198,20
9,220,231
120 DATA 242,32,18,130,32,18,130,32,204,255,169,10,162,6,14
1,32
130 DATA 208,142,134,2,169,3,160,144,76,30,171,165,1,41,254
,133
140 DATA 1,96,165,1,9,1,133,1,96,160,0,177,57,170,200,177
150 DATA 57,133,58,134,57,96,169,0,141,176,2,141,177,2,141,
178
160 DATA 2,141,64,3,141,80,3,141,96,3,160,4,177,122,153,60
170 DATA 3,240,27,200,192,14,144,244,177,122,153,66,3,240,1
5,200
180 DATA 192,24,144,244,177,122,153,72,3,240,3,200,208,246,
160,0
190 DATA 185,64,3,32,30,130,144,10,200,192,10,144,243,162,1
2,76
200 DATA 38,155,140,176,2,201,0,240,40,160,0,185,80,3,32,30
210 DATA 130,144,10,200,192,10,144,243,162,10,76,38,155,140
,177,2
220 DATA 201,0,240,13,160,0,185,96,3,240,3,200,208,248,140,
178
230 DATA 2,96,169,64,162,3,133,122,134,123,169,2,141,184,2,
96
240 DATA 169,80,162,3,133,122,134,123,169,3,141,184,2,96,16
9,96
250 DATA 162,3,133,122,134,123,169,4,141,184,2,96,32,121,0,
24
260 DATA 162,0,134,2,6,2,201,48,240,9,201,49,240,5,162,8
270 DATA 76,38,155,41,15,5,2,133,2,32,115,0,232,224,8,208
280 DATA 227,96,160,0,177,57,153,0,2,200,192,4,144,246,177,
57
290 DATA 153,0,2,240,3,200,208,246,169,0,162,2,133,122,134,
123
300 DATA 96,160,0,177,122,32,19,177,176,5,162,5,76,38,155,2
01
310 DATA 65,240,247,177,122,32,30,130,144,13,153,0,2,200,19
2,10
320 DATA 144,241,162,12,76,38,155,140,183,2,152,24,101,122,
133,122
330 DATA 165,123,105,0,133,123,96,169,0,162,160,133,59,134,
60,32
340 DATA 203,147,160,0,177,59,208,5,32,210,147,24,96,205,18
3,2
350 DATA 208,23,162,0,200,200,177,59,221,0,2,208,12,200,232
,236
360 DATA 183,2,144,242,32,210,147,56,96,169,13,24,101,59,13
3,59
370 DATA 165,60,105,0,133,60,76,18,149,32,98,148,32,209,148
,32
380 DATA 7,149,8,32,203,147,40,176,60,165,59,24,105,13,170,
165
390 DATA 60,105,0,201,192,144,10,138,201,0,144,5,162,2,76,3
8
400 DATA 155,160,0,173,183,2,145,59,200,169,0,145,59,200,16
2,0
410 DATA 189,0,2,145,59,200,232,236,183,2,144,244,160,13,16
9,0
420 DATA 145,59,56,176,11,160,1,177,59,240,5,162,1,76,38,15
5
430 DATA 173,184,2,201,2,240,5,32,210,147,24,96,32,112,148,
32
440 DATA 104,150,176,5,162,10,76,38,155,224,63,144,5,162,13
,76
450 DATA 38,155,224,61,208,26,32,126,148,32,210,147,165,59,
72,165
460 DATA 60,72,32,163,151,104,133,60,104,133,59,32,237,149,
56,96
470 DATA 165,61,166,62,133,20,134,21,32,237,149,24,96,32,20
3,147
480 DATA 160,11,165,20,145,59,200,165,21,145,59,160,1,152,1
45,59
1000 FORS=37632 TO 38399
1010 READA:POKES,A
1020 NEXT
1030 PRINT"FINISHED 2"
```

Assembler 3

```
10 DATA 76,210,147,32,209,148,32,7,149,176,2,24,96,32,203,1
47
20 DATA 160,1,177,59,208,5,32,210,147,24,96,160,11,177,59,1
33
30 DATA 253,200,177,59,133,254,32,210,147,32,121,0,201,43,2
40,4
40 DATA 201,45,208,42,72,32,115,0,32,163,151,104,201,43,208
,15
```

```
50 DATA 24,165,20,101,253,133,20,165,21,101,254,133,21,56,9
6,165
60 DATA 253,56,229,20,133,20,165,254,229,21,133,21,56,96,16
5,253
70 DATA 166,254,133,20,134,21,56,96,173,177,2,201,3,208,53,
169
80 DATA 176,162,146,133,251,134,252,162,0,160,0,177,251,217
,80,3
90 DATA 208,13,200,192,3,144,244,189,121,147,141,180,2,56,9
6,232
100 DATA 224,67,240,16,165,251,24,105,3,133,251,165,252,105
,0,133
110 DATA 252,76,121,150,24,96,177,90,201,255,240,3,141,180,
2,96
120 DATA 162,9,76,38,155,32,112,148,32,104,150,176,5,162,10
,76
130 DATA 38,155,224,8,176,3,169,1,96,224,33,176,3,169,2,96
140 DATA 224,56,176,3,169,3,96,224,64,176,3,169,4,96,162,13
150 DATA 76,38,155,141,182,2,152,72,172,181,2,165,20,153,16
0,3
160 DATA 200,173,182,2,201,1,240,6,165,21,153,160,3,200,140
,181
170 DATA 2,104,168,96,173,178,2,240,1,96,162,14,76,38,155,3
2
180 DATA 4,151,32,126,148,32,163,151,165,21,240,5,162,7,76,
38
190 DATA 155,169,1,32,227,150,32,121,0,201,44,208,6,32,115,
0
200 DATA 76,21,151,96,32,4,151,32,126,148,32,163,151,169,2,
32
210 DATA 227,150,32,121,0,201,44,208,6,32,115,0,76,58,151,9
6
220 DATA 32,4,151,32,126,148,160,0,185,96,3,153,160,3,240,3
230 DATA 200,208,245,140,181,2,96,32,4,151,32,126,148,32,16
3,151
240 DATA 165,20,166,21,133,21,134,20,169,2,32,227,150,32,12
1,0
250 DATA 201,44,208,6,32,115,0,76,109,151,96,32,4,151,32,12
6
260 DATA 148,32,163,151,165,20,166,21,133,61,133,63,134,62,
134,64
270 DATA 76,121,0,169,0,133,20,133,21,32,121,0,201,36,208,1
3
280 DATA 32,115,0,169,255,141,174,2,32,21,130,56,96,201,37,
208
290 DATA 12,32,115,0,32,140,148,165,2,133,20,56,96,201,60,2
40
300 DATA 4,201,62,208,36,72,32,115,0,32,163,151,176,12,173,
179
310 DATA 2,201,1,240,5,162,3,76,38,155,104,201,60,240,4,165
320 DATA 21,133,20,169,0,133,21,56,96,32,27,130,144,10,169,
0
330 DATA 141,174,2,32,21,130,56,96,201,39,208,10,32,115,0,1
33
340 DATA 20,32,115,0,56,96,32,19,177,176,5,162,5,76,38,155
350 DATA 32,3,150,144,1,96,173,179,2,201,1,208,2,24,96,162
360 DATA 3,76,38,155,169,0,141,181,2,32,112,148,32,181,150,
201
370 DATA 4,208,3,76,158,152,201,2,208,4,169,1,208,13,201,1
380 DATA 208,6,32,211,152,76,91,152,32,33,153,141,182,2,173
,180
390 DATA 2,160,0,153,160,3,200,204,182,2,240,17,165,20,153,
160
400 DATA 3,200,204,182,2,240,6,165,21,153,160,3,200,140,181
,2
410 DATA 173,181,2,240,24,173,179,2,201,2,208,3,32,33,156,2
4
420 DATA 173,181,2,101,61,133,61,165,62,105,0,133,62,96,224
,56
430 DATA 208,6,32,15,151,76,205,152,224,58,208,6,32,52,151,
76
440 DATA 205,152,224,57,208,6,32,80,151,76,205,152,224,59,2
08,6
450 DATA 32,103,151,76,205,152,224,60,208,3,32,139,151,172,
181,2
460 DATA 76,125,152,32,4,151,173,179,2,201,2,240,3,169,2,96
470 DATA 32,126,148,32,163,151,165,21,208,3,76,22,153,165,6
1,24
480 DATA 105,2,133,253,165,62,105,0,133,254,165,20,56,229,2
53,133
1000 FORS=38400 TO 39167
1010 READA:POKES,A
1020 NEXT
1030 PRINT"FINISHED 3"
```

Assembler 4

```
10 DATA 20,165,21,229,254,240,9,201,255,240,14,162,4,76,38,
155
20 DATA 165,20,201,128,176,245,169,2,96,165,20,201,128,144,
236,176
30 DATA 245,169,180,24,109,180,2,133,90,169,145,105,0,133,9
1,32
40 DATA 4,151,32,126,148,32,121,0,201,65,208,21,32,115,0,32
50 DATA 30,130,176,8,160,0,32,166,150,169,1,96,162,5,76,38
60 DATA 155,201,35,208,25,32,115,0,32,163,151,144,14,165,21
,240
70 DATA 5,162,7,76,38,155,160,1,32,166,150,169,2,96,201,40
80 DATA 208,3,76,3,154,173,179,2,201,2,240,14,173,180,2,201
90 DATA 121,240,4,201,110,208,3,169,3,96,32,163,151,176,3,1
69
100 DATA 3,96,165,21,208,64,32,121,0,201,44,240,27,173,180,
2
110 DATA 201,110,240,4,201,121,208,8,160,5,32,166,150,169,3
,96
120 DATA 160,2,32,166,150,169,2,96,32,115,0,201,88,240,9,20
1
130 DATA 89,240,8,162,8,76,38,155,160,3,44,160,4,32,166,150
140 DATA 32,115,0,169,2,96,32,121,0,201,44,240,8,160,5,32
150 DATA 166,150,169,3,96,32,115,0,201,88,240,9,201,89,240,
8
160 DATA 162,8,76,38,155,160,6,44,160,7,32,166,150,32,115,0
170 DATA 169,3,96,32,115,0,32,163,151,32,121,0,201,44,240,5
9
180 DATA 201,41,240,5,162,8,76,38,155,32,115,0,201,44,240,1
1
```

```
190 DATA 160,10,32,166,150,32,115,0,169,3,96,32,115,0,201,8
9
200 DATA 240,5,162,8,76,38,155,165,21,240,5,162,7,76,38,155
210 DATA 160,9,32,166,150,32,115,0,169,2,96,32,115,0,201,88
220 DATA 240,5,162,8,76,38,155,32,115,0,201,41,208,244,165,
21
230 DATA 240,5,162,7,76,38,155,160,8,32,166,150,32,115,0,16
9
240 DATA 2,96,32,121,0,208,19,169,66,160,144,32,30,171,32,9
6
250 DATA 165,134,122,132,123,32,115,0,240,232,32,9,130,142,
224,2
260 DATA 132,251,160,2,132,252,160,0,177,251,153,225,2,200,
204,224
270 DATA 2,144,245,32,121,0,32,9,130,142,240,2,132,251,160,
2
280 DATA 132,252,160,0,177,251,153,244,2,200,204,240,2,144,
245,169
290 DATA 64,162,48,160,58,141,241,2,142,242,2,140,243,2,174
,240
300 DATA 2,169,44,157,244,2,232,232,157,244,2,202,169,80,15
7,244
310 DATA 2,232,232,169,87,157,244,2,232,232,232,232,142,240
,2,96
320 DATA 173,0,3,174,1,3,141,60,3,142,61,3,169,28,162,155
330 DATA 141,0,3,142,1,3,96,173,60,3,174,61,3,141,0,3
340 DATA 142,1,3,96,32,204,255,169,3,76,195,255,224,11,208,
4
350 DATA 162,8,208,2,162,7,134,2,32,210,147,32,20,155,32,7
360 DATA 155,32,1,156,169,82,160,144,32,30,171,165,2,10,170
,189
370 DATA 148,145,188,149,145,32,30,171,169,157,160,144,32,3
0,171,160
380 DATA 2,177,57,170,200,177,57,133,58,134,57,32,194,189,1
69,1
390 DATA 141,174,2,162,26,108,0,3,165,43,166,44,133,57,134,
58
400 DATA 169,0,133,63,133,61,133,64,133,62,32,178,148,160,1
,177
410 DATA 57,240,34,32,230,147,173,179,2,201,1,208,10,173,17
6,2
420 DATA 240,5,32,73,149,176,8,173,177,2,240,3,32,52,152,32
430 DATA 217,147,76,122,155,96,169,1,162,8,160,1,32,186,255
,173
440 DATA 224,2,162,225,160,2,32,189,255,24,169,0,32,213,255
,176
450 DATA 59,96,169,3,162,8,160,3,32,186,255,173,240,2,162,2
41
460 DATA 160,2,32,189,255,24,32,192,255,176,33,32,235,155,1
65,63
470 DATA 32,240,155,165,64,32,240,155,76,204,255,162,3,76,2
01,255
480 DATA 32,210,255,32,183,255,208,1,96,32,20,155,162,15,76
,38
1000 FORS=39168 TO 39935
1010 READ A:POKES,A
1020 NEXT
1030 PRINT"FINISHED 4"
```

■

Assembler 5

```
10 DATA 155,162,15,32,201,255,169,83,141,241,2,174,240,2,20
2,202
20 DATA 202,202,169,0,157,241,2,169,241,160,2,32,30,171,76,
204
30 DATA 255,32,235,155,162,0,189,160,3,32,240,155,232,236,1
81,2
40 DATA 144,244,32,204,255,32,201,156,96,32,177,147,32,36,1
30,32
50 DATA 240,154,32,114,154,32,166,155,169,0,162,160,133,251
,134,252
60 DATA 160,0,152,145,251,169,1,141,179,2,32,104,155,32,165
,157
70 DATA 32,194,155,238,179,2,32,104,155,32,57,157,32,20,155
,32
80 DATA 7,155,162,15,32,195,255,169,1,141,174,2,76,0,130,20
1
90 DATA 10,144,3,105,54,96,9,48,96,72,74,74,74,74,32,127
100 DATA 156,157,0,2,104,41,15,232,32,127,156,157,0,2,232,9
6
110 DATA 169,0,157,0,2,173,175,2,240,5,162,200,32,201,255,1
69
120 DATA 0,160,2,32,30,171,32,18,130,76,204,255,162,0,169,3
2
130 DATA 157,0,2,232,224,80,144,248,96,32,188,156,162,0,165
,62
140 DATA 32,137,156,165,61,32,137,156,173,181,2,240,23,201,
3,144
150 DATA 2,169,3,133,94,162,5,160,0,185,160,3,32,137,156,20
0
160 DATA 196,94,144,245,173,176,2,240,17,162,12,160,0,185,6
4,3
170 DATA 157,0,2,232,200,204,176,2,144,243,173,177,2,240,17
,162
180 DATA 22,160,0,185,80,3,157,0,2,232,200,204,177,2,144,24
3
190 DATA 173,178,2,240,17,162,32,160,0,185,96,3,157,0,2,232
200 DATA 200,204,178,2,144,243,76,160,156,169,0,162,160,133
,251,134
210 DATA 252,173,175,2,240,5,162,200,32,201,255,169,104,160
,144,32
220 DATA 30,171,32,204,255,32,203,147,160,0,177,251,208,4,3
2,210
230 DATA 147,96,133,2,32,188,156,200,200,162,0,177,251,157,
0,2
240 DATA 200,232,228,2,144,245,162,11,169,61,157,0,2,162,13
,160
250 DATA 12,177,251,32,137,156,136,177,251,32,137,156,169,1
3,24,101
260 DATA 251,133,251,165,252,105,0,133,252,32,210,147,32,16
0,156,32
270 DATA 203,147,76,88,157,173,175,2,240,5,162,200,32,201,2
55,169
280 DATA 134,160,144,32,30,171,76,204,255
1000 FORS=39936 TO 40376
1010 READA:POKES,A
1020 NEXT
1030 PRINT"FINISHED THE LOT!"
```

■

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